

THE LARCH

A PRACTICAL TREATISE

ON

ITS CULTURE AND GENERAL MANAGEMENT

BY

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ON THE LARCH FORESTS; DISEASES OF FOREST TREES, AND
OTHER SUBJECTS; ALSO, ESSAYS TO THE SCOTTISH
ARBORETCULTURAL SOCIETY ON TRANSPLANT-
ING LARGE TREES, ETC. ETC.

NEW EDITION, WITH AN

INTRODUCTION ON THE LARCH DISEASE

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BY HIS OBEDIENT SERVANT

THE AUTHOR.

PREFACE.

IN writing a book, of however humble pretensions, it is expected that the Author should be able at least to say why he does so, since the world is already full of books, and the time for their perusal so limited. To repeat what has already been stated is to trifle with time; to state what is true, but not new, is to trifle with one's self; and to set forth statements that are new, but not true, is to attempt to impose upon others, which no one has any right to do.

The Author of the present work makes no pretensions to literature, neither to genius nor discovery; but after fully thirty years extensive forest practice—although he does not flatter himself that he has learned all that is to be learned upon the subject, “The Larch”—he yet hopes that he has accumulated sufficient information to justify him in this undertaking.

The book is the legitimate product of many years' labour and investigation, and, as far as the Author is aware, it is the only treatise on the subject by a prac-

tical forester. All that is most pressingly wanted to be known respecting the Larch, whether as a tree, forest, domestic, or commercial product, will, he trusts, be found within its pages, and will either constitute the groundwork of nobler and better structures, or suggest new lines of research and inquiry.

Any one whose spirit is at all in sympathy with nature must often feel sorry, if not distressed, at seeing the Larch-tree so frequently undergoing the process of martyrdom, to which it seems doomed, without an effort being made for its deliverance.

The writer has endeavoured throughout to make the book as much as possible a practical reference-book and manual; and although there may appear not a few irrelevancies, and perhaps new theories, it must be borne in mind that any practical subject will be rendered all the less so by a too rigid adherence to abstract rules and principles.

In conclusion, the Author begs leave to return his sincere thanks to the numerous indulgent friends (many of whom he never saw) who have so generously contributed their quota of varied and valuable information, not a little of which, it is to be regretted, is withheld for want of space.

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INTRODUCTION.

THE LARCH DISEASE.

WE had flattered ourselves that all had already been said in the following pages that could be said, or at least that ~~was~~ necessary to say, not only in regard to the larch disease but on the larch in general. In this, however, we are evidently mistaken, for there still resounds the familiar cry, "The larch disease, and how to prevent it." We intentionally delayed reverting to the subject till the International Forestry Exhibition in Edinburgh had exhausted its resources, the jurors had given their awards, and the public manifested their opinion; but now that the Forestry Exhibition is over, and the curtain fallen, without, so far as we are aware, revealing anything new, or even throwing a single ray of light upon any phase of the old subject, we shall once more endeavour, however feebly, to clear up what to many is not only a dark and perplexing question, but a bewildering and profound mystery. There were many samples of

Larch exhibited at the International Forestry Exhibition, showing it in one or other of its varied and interesting phases. These specimens presented the larch not only in its highest and noblest aspects, but also in its lowest possible condition. For the former description, we have only to look at such specimens as the two splendid root-sections from Craigdarroch, Dumfriesshire, measuring respectively 27 and 28 inches diameter at twelve feet from the ground, than which no better sample of tree or timber need be sought for or desired in any country; the specimen sections from Bishop's Castle, Shropshire, in which 120 years' growths were counted; the splendid sections from Rossdhu, Luss, Dumbartonshire; those by His Grace the Duke of Buccleuch, from Canonbie, Dumfriesshire; from Barron's Court, Tyrone, Ireland, by His Grace the Duke of Abercorn, showing the excellent growth of the tree in the north of Ireland; in the high perfection of the wood (22 inches of duramen) growing at Panmure, Carnoustie, Forfarshire; the splendid sections from Methven Castle, Perthshire; in that exhibited by Sir R. A. E. Cathcart, Bart., Killochan Castle, Ayrshire: whilst for the latter description, look at the diseased specimens from Ashford, County Galway, Ireland; from Scone Palace, Perthshire, exhibited by Mr M'Corquodale, wood manager of the estates; the New Forest specimens from the county of Hants, showing the different colour of wood produced by being grown on different soils—as light colour in peat, and dark red on loam, &c; and the

THE LARCH DISEASE.

dry-rot, blister, and other diseases exhibited by Mr. McGregor, Dunkeld, from the Athole forests. The latter specimens bring us not only to the door, but into the very lazar-house itself, where were to be seen, in almost every deformity and infirmity larch is heir to, diseases hideous and loathsome. Ulcerous sores or blisters were shown in every part of the tree, from the base of the stem to the uppermost bough, both inclusive. In these may be seen what is lamented by every forester in the kingdom,—in such different degrees, however, that in one case it is so mild as to be scarcely traceable or observable, while in others it is deep-seated and ruinous to a degree. The blisters complained of begin in the bark, and are less or more hurtful to the tree according as they are confined or spread over its surface. If the blisters cover only one-third, or even one-half, of the surface of the bark, on one side of the tree, in such circumstances the tree ultimately outgrows the disease; and although a scar or mark may for ever afterwards remain on the tree, whether concealed or observable, yet it neither dies on account of it, nor does it seriously interfere with its growth. It is perhaps saying too much, to affirm that the blisters do no positive injury to any other member or part of the tree beyond the part actually affected; but on the other hand (and herein lies the wide difference between the plant and the animal), it satisfactorily shows that while large unsightly scars and suppurating wounds do exist in their most inveterate and malig-

nant forms, yet the roots and all other parts of the stem and branches remain perfectly sound and healthy. In confirmation of this, we have only to look at some of our largest, oldest, and finest trees when sawn up, and we find that in their early growth they had mostly all been less or more affected with the disease under consideration. Having made these general observations, we shall now endeavour to point out how the diseases are produced; under what conditions they originate, and are aggravated; and also how to cure, or rather, let it be said, prevent their occurrence.

This disease in the larch appears at every stage of growth,—from that of two years old in the nursery-ground to the tree of over thirty feet in height and as many years old. It occurs in trees grown from all kinds and qualities of seed, whether home-grown or foreign. It also exists upon all kinds of soil, including sand, clay, loam, moss, peat-bog, &c. It is found on soils loose, free, and open, as well as on those stiff, hard, and retentive; on deep, rich, and alluvial soils, as well as on the thin, poor moorland. It is met with at every altitude, from that at sea-level to over 1500 feet. It may indeed with perfect truth be said that it contracts the disease in question in all situations, in every kind and description of soil, and at every altitude; as grown from seed alike of home and foreign growth, or from selected seed, plump and sound, as well as from sickly and weak seed; from trees, also, that have been thoroughly

hardened and acclimatised, as well as from those of recent importation. From this dark and ominous description, it may appear that perfectly sound and healthy larches must be a very scarce and rare production indeed, while diseased and unhealthy ones must constitute the general and ordinary crop. It is quite true that there are very many diseased larches to be found all over the country,—in some districts more and in others fewer; some of a mild and others of a virulent kind. In some plantations, and even wide districts, it is rare to find a perfectly sound and healthy tree, whilst in others diseased ones are equally as rare to be found. In order, however, to make the subject truly useful and practical, it will be necessary to arrive at definite conclusions: and in order the better to do this, we shall describe, first, the conditions under which the trees are found diseased; and secondly, the conditions under which they are found sound and healthy.

Diseased trees, or such as are found affected with blister, are most commonly to be met with in wet damp soils, and where cold currents of wind during the season of growth beat upon them. The bark of the young trees, as will be found repeatedly stated throughout the pages of the book, is exceedingly sensitive and tender till such time as it attains that stage of perfection at which it becomes rough, scaly, and hard. It is not easy to say definitely either what the age or size of the tree is when it is safe from the disease in question, for it varies considerably in

different trees, according to their fastness or slowness of growth, quality and condition of soil, climate, exposure, &c. Generally speaking, however, the bark of the tree, when over fifteen years old, may be regarded as proof against this form of disease. Observe, it is not said the tree is safe when fifteen years old, but that the bark at fifteen years old is safe; and as the bark is first formed at the base, because growth begins there, so at the termination of every year's growth the bark of that period is one year younger than that of the growth below, and so on to the top shoot, which is only one year old. A tree, for example, that makes 18 inches of top growth every year, is $22\frac{1}{2}$ feet in height at fifteen years old, at which age it is assumed the lower part of the tree is proof against disease. Assuming, therefore, that the bark is disease proof at fifteen years old, the lower 18 inches of the tree are only so at first, and an additional 18 inches safe every succeeding year thereafter throughout its growth. When the tree attains the age of thirty, at the above computation of growth it is 45 feet in height, and the lower $22\frac{1}{2}$ feet of the stem are disease proof. The younger the tree, it will thus appear, the more is it liable to disease, and the older of course the less liable. At what age, it will naturally be asked, is the whole tree entirely safe and disease proof? To that question it is difficult to give a satisfactory answer, for as long as the tree is growing and making new wood, there is always the new and young bark in connection with it, and which is

almost as liable to contract disease till it is fifteen years old as the bark of the first year's growth was. Not only is the bark of the *stem* very tender and liable to disease when young, but that of the *branches* equally as tender; hence the frequent appearance of withered twigs and branches, not only upon very young trees, but upon those of advanced growth as well. The blister, which thus affects the branches just in the same way that it does the stem, causes them frequently to die in large numbers; and many a tree has been cut down as vitally diseased on presenting this appearance, whereas, had the cause been properly understood, and the tree allowed to grow, it would in a few years have clothed itself anew with spray and branches, emanating either from the healthy base of the decayed ones or from the stem itself, or from both. As already said, in consequence of the young smooth bark being so very sensitive and tender,—not so much against frost or cold as against dampness and wet in its early stages of growth,—it is not to be wondered at that it is seriously affected by cold, and especially cold damp winds, dull moist weather, want of sunshine, and slow evaporation during the growing season, at which time this and mostly all tree diseases are contracted.

Having, it is hoped, described sufficiently the conditions under which this disease is contracted, it now remains to state under what conditions the tree can be grown healthy and free of such disease. The larch, we again affirm, is the most tender of all our forest trees during its summer growth; but while that

is true,—and none will attempt to disprove it,—it is equally true and capable of proof that it is one of our very hardiest of winter trees. It is therefore imperative that, in planting larch, the soil, climate, and situation be such as is adapted to the tender summer tree and to the hardy winter one—both of which the larch emphatically is. This may also be said of it without fear of contradiction: it will grow well even in the thinnest and poorest of soils. Hence there need be no hesitation in planting it in any soil, however thin and poor, if only dry, and sufficiently open for the roots to enter. It also likes a kindly situation—not necessarily a south exposure; for the larch grows as well on the north as on the south side of a hill or valley. It greatly prefers a dry atmosphere to all others: a cold damp atmosphere it cannot endure, and therefore a dry and clear atmosphere suits it. It stands sea exposure badly, by its foliage suffering during summer gales and breezes, not to speak of hurricanes.

The larch aphid is looked upon by some as a disease, almost as much to be dreaded as either the blister or heart-rot. We do not so regard it. The larch aphid is, in our humble opinion, not a disease, properly speaking, but the result of a blight or stagnation of growth, sometimes produced by one cause, and sometimes by another and totally different cause. When the tree grows in a sheltered situation, and in a soil naturally rich and damp, and any extreme change of weather overtakes it, such as a dry scorching sun, or severe drought or frost, under such conditions the aphid makes its appearance, and commits considerable ravages

on the foliage. But when air is admitted, as by judicious thinning, or a favourable change of weather takes place, with genial showers of rain, it usually disappears from the foliage, but may remain dead or dying upon the stem and branches for weeks or even months afterwards. The aphid, as many are aware, was exhibited on a live larch at the Forestry Exhibition by Mr M'Gregor. The tree referred to was lifted with a ball of earth attached to the roots, and placed in soil. It was 4 feet 1 inch in height, and showed five years' growth, exclusive of that of the current year 1884, when it made only $2\frac{1}{2}$ inches of top-growth—as much, probably, as might be expected under the circumstances. The stem measured only three-fourths of an inch in diameter at the surface of the ground, and the branches were very small, slender, and delicate, and the foliage of a light sickly hue. The longest shoot it had ever made was the third from the bottom; and that year's growth had on it a blister sufficient of itself to account for the sickly and weak condition of the tree. It will be inferred, however, from the diameter and height of the stem, that the tree had been grown under such unfavourable conditions as to encourage disease, which the aphid indicated; for, as has been repeatedly shown by the writer, a young tree, in order to health and prosperity, should girth as many inches near the ground as it stands feet in height, so that in this case the girth, instead of being only 2 inches, should have been fully 4 inches. Having been unfavourably grown by confinement may account for the blister; and the blister may of itself, or in com-

combination with the unfavourable culture of the tree, account for the aphid. It would have been instructive to have brought a healthy tree into the Exhibition, and to have observed whether it contracted the aphid or not in its state of confinement, and seclusion from its natural element.

We have endeavoured to describe the disease known as blister, which affects primarily the bark, and which may be regarded as the leaf or foliage disease, and now we shall describe the root and trunk disease, or what is popularly known as pumping. This disease, or decay of the tissues of the wood is the result, generally speaking, of the tree growing in soil unsuitable to it. It is always worse upon ground that had formerly been under cultivation, than upon land that never was ploughed or had tasted manure. Thin poor soil, with a cold uncongenial subsoil, which had undergone a rotation of cropping, is that which produces heart decay more than any other. The tree on this kind of soil, after fairly starting in growth, grows very rapidly for a time, and consequently produces wood soft and spongy. This rapid growth goes on as long as the roots derive food from the fertile active soil; but as soon as this is exhausted, and the roots reach the hard unsuitable subsoil, the tree begins to fall off in growth. This kind of decay first begins in the roots, and extends through their tissues into the trunk. It, however, assumes various forms and presents different appearances, both in individual trees and at different periods of their growth. When it is observed, by their bulged form of growth and other indications, that the

trees are affected with rot or decay of the timber, they should at once be cut down and converted into what they are best adapted for—such as fence-posts. To prevent this form of decay, the ground, if naturally unsuitable for growing sound timber, is better to be laid up in ridges or narrow mounds before planting—which, if arable, it is easy to do with the plough, by first laying four furrows together and planting the trees in single rows along the centre of the mound, as directed at p. 279. It is also in its favour to give the trees, till ten or twelve years of age, perfect freedom to spread their roots and branches. The twigs and spray of the larch are often found to wither and dry up suddenly and unaccountably about May or June. This phenomenon often creates no small alarm in those who have an interest in the tree. It is usually the result of what had happened to the tree the year previous: the bark had been injured by damp, cold winds, sometimes combined with frost, or, what is often more common and injurious, dull, cold, wet weather, during the flow of the sap. The bark of the twig is found, on examination, to be quite inert, and of a darkish cinnamon colour. On older and larger branches, the result of injury to the bark is less sudden than to the young spray: in the latter case the twig usually withers and dries up the first year after it receives the injury, while in the former it may not fully appear till the lapse of several years. Withered tops are often the result of severe spring and summer frosts; and it will be observed that all trees very severely exposed to the north have lost their

tops repeatedly. Some old trees in the policies at Cullen House have lost their leader as often as six times, and always regained it. This, it is needless to say, can only be prevented by shelter; and any one acquainted with the growth of trees readily knows what the situation ought to be in which to grow tall and slender or short and bushy trees.

The forms of disease thus enumerated may, for the sake of better remembering them, be recapitulated:—

1. The root disease, termed ground-rot.
2. Stem disease, termed rot or pumping.
3. Bark disease, designated blister or cancer.
4. Leaf disease, termed aphid.

5. Twig or spray disease may also be termed bark disease, as it is the bark that first suffers, and is the producing cause of it.

6. Branch disease is likewise bark disease, and is the remote producing cause of staghorn and withered tops.

There is yet one other very singular peculiarity about the larch which deserves to be better known, and which we are unable to account for or explain. On thinning a plantation, or relieving a larch tree from anything closely encroaching upon it and confining it, although the tree has stood in the most unfavourable position for half a century or more, and although the branches and foliage have been reduced by such confinement to a mere top tuft, yet no sooner is the imprisoned tree set at liberty than it begins to grow, and flourish like one in the prime of life, and in perfect health. The tree referred to at p. 29 is an example of what is here meant. In the case of all

other species of forest trees we have examined, we have found that the growth or increased thickness of the layers only begins with the additional new, and invigorated branches, and increases or decreases with them. If they flourish, so do the layers increase; if they become unhealthy or sickly, the layers decrease. Now in the larch no such connection appears to exist between the growth of the branches and the growth of the stem, and this is what we cannot by any known law account for. What actually takes place is, that whenever the surface of the tree is fully and freely exposed to the sun and air, the stem of the tree derives such an impetus of growth therefrom as to quite astonish us. We knew of many confined trees with only a few branches on their top; yet the branches, after being relieved and set free, only grew in the very smallest proportion to the trunk itself. Trees which during fifty years had only grown at an average of less than $\frac{1}{4}$ of an inch in the annual layer, after being thinned and set free, grew at over $\frac{1}{2}$ of an inch annually; but the branches, strange to say, had not made any perceptible increase in growth. Having directed close attention to this aspect of the subject for a number of years, and had repeated examples brought before us, no doubt remains in our mind as to the reality of the phenomenon. We therefore, without hesitation, strongly recommend the subject to those whose time and talents admit of thoroughly investigating it. This to us appears a phase of plant physiology which, if duly thought out, may be of very great practical utility in the

culture of plants, and specially of forest trees. In some unhealthy larch plantations in Perthshire, Sussex, and elsewhere, all the trees were cut down except a few, to see what would become of them. In several instances of this kind, where the trees were left single, they immediately began and continued to grow at such a marvellous rate, as to perfectly astonish both those who made the experiment and others who beheld them. Not only was the accelerated growth marvellously good and great, compared with the ordinary growth, but it far transcended that of any other tree in the forest, whether pine, fir, or hardwood. About twenty years ago we had a cross section cut from an oak-tree on a hill-top near Abbotsford, on Tweedside, which had been left standing on cutting down the surrounding trees of other sorts; and the section, which we still possess, shows the growth in the very reverse order to that noticed and described in the larch, for, instead of growing faster after being exposed, it grew very much slower. We have only one theory by which to explain and account for the newly-discovered phase of growth in the larch—namely, in all those cases showing the growth to be remarkably fast, the trees grew in damp or wettish ground, and it is just possible that this unusual growth might to a considerable extent be the result of the combined action of the sun and air acting chemically upon the juices of the tree, supplied by the superfluous moisture of the soil. This, however, is little more than a hazy conjecture, and may therefore, meanwhile, be very properly left awaiting more light.

THE LARCH.



CHAPTER I.

BOTANICAL CHARACTERISTICS.

THE larch—botanically *Larix*—is a genus of hardy, deciduous timber trees, of the first division of the coniferous order. It differs from all the other genera of the fir sub-order, except cedars, in having its leaves chiefly solitary on the young shoots, but always fasciculated on the old twigs, with the bud of a future growth of leaves in the centre of its fascicle. It differs also from the other firs and from the pines in the form of its stigma, which is neither bifid nor trifid, as in their case, but semi-globular, cupped, and glandular. Again, it differs from all trees of the same tribe in being deciduous, and from cedars in the scales of its cones being of a much less proportionate breadth, and having a pretty regular round or oval form.

“The European or common white larch (*Larix europæa*), called by Linnæus *Pinus larix*, is a native of the

Swiss Alps, of other mountainous districts towards the north of Europe, and of some districts in the north of Asia, and was introduced from Germany into Britain about the year 1629. Its trunk is straight and tall, and its outline is conical or pyramidal. Its branches grow in a remotely whorled arrangement, and for the most part spread horizontally from the trunk, but occasionally, and especially when old, are somewhat pendulous. Its leaves are linear, soft, rounded or blunt at the point, and of a pleasant light-green colour, spreading and slightly recurved round a central bud, or bunched together with a somewhat similar appearance to the pencils or little brushes of the painter. The male catkins are stalkless, somewhat globular, and of a bright yellow colour, and are shed in April and May. The female flowers or embryo cones vary from a whitish to a bright reddish colour, and appear about the same time as the male catkins. The cones are erect, fully an inch long, of an oblong-ovate form, and deepen in colour as they ripen. The cone scales are persistent, roundish, and striated; while the bractes, especially those towards the lower part of the cones, are generally longer than the scales. The seeds are fully an eighth of an inch long, and have an irregular or ovate form, and each has from five to seven cotyledons, and is more than half enveloped in a persistent, smooth, shining perisperm.

“The *Larix pendula*, or black larch, is not so generally known in this country as it ought to be. It differs from the European species in the following particu-

lars:—Its leaves and cones are considerably smaller, the latter being only about half the size of those of the common larch. It bears so strong a resemblance to the European larch, that by many it is considered to be only a variety. It grows to a large size, and thrives well at an elevation equal to that at which the common larch will grow. Its trunk is smooth, straight, tall, and slender, being frequently three feet diameter in its best condition, and rising to the height of a hundred feet in places suited to its growth. Like the European species, its wood is tough and durable; its specific gravity is so great that its weight is sometimes regarded as an objection to it. It is extensively used in ship-building and every other purpose to which the wood of the common larch is applied.

“There is another species or variety, known in America as the *microcarpa*, which also has pendulous branches, but it is distinguishable from the above variety by its minute and small fruit. Sir A. B. Lambert describes it as a distinct species, while others regard it, and probably more correctly, as only a variety. Its wood, like that of the tamarac, is durable, tough, and heavy, and its uses are similar to those of the common European larch. I have heard it stated that the Duke of Athole planted several of the *Larix pendula* about Dunkeld; but it is said they never attained the same size and perfection as those of the common European species. Whatever be the relative value for forest culture between them and the common larch, it is certain that both species are wonder-

fully hardy, and well adapted to the climate and soil of Great Britain.

“The common white larch fir (*Larix europæa*) belongs to the class Monœcia of the Linnæan system, and is the only deciduous cone-bearing tree known. It is a native of the Dalmatian Alps of France and Switzerland, as well as of the Apennines in Italy; while another but different species is found in Russia. It is also indigenous on all the rocky and high mountains in Germany and Hungary, and the Carpathian Mountains.”

CHAPTER II.

HISTORY AND INTRODUCTION INTO GREAT BRITAIN.

A GREAT many towns, we are told, contended for the honour of being the birthplace of Homer. In like manner, the credit of having introduced the larch has been claimed by numerous planters, and it is now difficult, if not impossible, to assign to any one person the priority. Some say they were first planted in England, and others that they were first planted in Scotland.

A writer in the Highland Society's "Transactions" says: "Loudon gives many details as to the early planting of the larch in Scotland and elsewhere, but he nowhere mentions Linley, which is somewhat remarkable, if it was early planted there. Nevertheless, it is certain, both from the appearance of the trees now existing there and from the tradition of workmen on the estate, that some of the very earliest planted larches, if not the earliest, are at Linley. On one tree that was blown down, Mr. Boscowen tells us that he counted a hundred and twenty rings, and these did not represent the full age of the tree. There is a fine specimen on the lawn, with, as usual in larches of that age, one or more of its principal branches much longer than the rest, and abruptly bent upwards. This tree

in particular has the local reputation of being the first larch planted in England. Moreover, in the following plantations a group of fine larches may be seen, which may well be contemporary with those at Dunkeld. There is a tradition, indeed, that they were really planted at the same time. The Duke of Athole and Mr. More were fellow-members of the Council of the Royal Society, and the story runs that More planted them the week before those at Dunkeld, and that hence the Linley larches and those at Dunkeld came from the same batch; but the most surprising feature perhaps is a clump of larches of about the same size and age as the famous larches of Dunkeld. The planting of the beautiful valley was evidently done by a man of knowledge, judgment, and taste, the groups being placed with a view to effect, monotony of form and colour being avoided by the disposition of the masses"

The exact date of its introduction into England, and by whom, will probably remain unknown; but well-authenticated accounts state that it was introduced about the end of the sixteenth or beginning of the seventeenth century. Gerard, a physician in London, in his Catalogue published in 1596, mentions the larch. Parkinson, a London apothecary, writing in 1629, gives an account of its introduction into England, and speaks of it as a rare tree, associating it with the ornamental class rather than the useful. Again, in his "*Theatrum Botanicum*," pp. 1533-34 (published in 1640), he gives a full description of the larch, with an account of its uses and virtues. Evelyn, in his first edition of

"Silva," published in 1662, gives such an account of it as to lead to the conclusion that it had at that period been a considerable number of years in this country; for he speaks of trees being of goodly stature, and their branches hoary with lichens, indicating that they had stood to old age and attained large dimensions. Such trees may have grown very rapidly, and attained a great height and a green old age—unless, indeed, we conclude Evelyn had mistaken the tree, which he evidently sometimes did. Miller, in his first number of the "Gardener's Dictionary," published in 1731, says the tree was then common in England, and some trees of large size at Wimbledon were bearing cones abundantly.

In another edition of his "Dictionary," published in 1759, he says the larch is plentiful and common in most of the English nurseries, many trees being planted in forest ground, while those in the poorest and worst soil are growing best.

As already said, it is uncertain who really introduced the larch into Britain, and the exact date of its first being planted. It is, however, stated that Sir James Nasmyth, Dawick House, Peeblesshire, planted some trees about 1725, and that Lord Kames planted some at Blair-Drummond in 1734. Mr. Menzies of Migeny, in Glenlyon, Perthshire, planted some at his residence in 1738, of which more will be said hereafter. These he brought from London in his portmanteau, and tradition says that of the same sample he made a present of sixteen small plants to His Grace

the Duke of Athole, five of which were planted at Dunkeld and eleven at Blair-Athole. Those left at Dunkeld were for a time kept in the greenhouse, but either on account of their rapid growth or apparent sickness by shedding their leaves, they were turned outside to do for themselves, and two of them (as shown in our illustration) still remain, but are very different plants now.

That the larch ran many narrow escapes of entire expulsion and repudiation is confirmed by John Evelyn in his "Silva," where he says: "I had in the former editions of 'Silva' placed the *Larix* among the trees which shed their leaves in winter (as indeed does this), but not before there is an almost immediate supply of fresh leaves; and may, therefore, both for its similitude, stature, and productions, challenge rank among the coniferous. We raise it of seeds, and it grows spontaneously in Stirria, Carinthia, and other Alpine countries. The change of the colour of the old leaf made an ignorant gardener of mine eradicate what I had brought up with much care, as dead; let this, therefore, be a warning. The leaves are thin, pretty long, and bristly, the cones small, grow irregular, as do the branches, like the cypress; a very beautiful tree, the ponderous branches bending a little, which makes it differ from the Libanus cedar, to which some would have it allied, nor are any found in Syria. Of the deep wounded bark the purest of our shop turpentine (at least as reputed), as also the drug agaric. That it flourishes with us, a tree of good stature (not long

since to be seen about Chelmsford in Essex) sufficiently reproaches our not cultivating so useful a material for many purposes where lasting and substantial timber is required, for we read of beams of no less than 120 feet in length made out of this goodly tree, which is of so strange a composition that 'twill hardly burn, whence 'Mantuan et robusta larix igni impenetrabile lignum,' for so Cæsar found it in a castle he besieged built of it (the story is recited at large by Vitruvius, 1.2.0.9.), but see what Philander says upon the place on his own experience; yet the coals thereof were held far better than any other for the melting on iron and the locksmith, and to say the truth, we find they burn it frequently as common fuel in the Valtoline, if at least it be the true Larix, which they now call Melere. There is abundance of this larch timber in the buildings at Venice, especially about the palaces in Piazza San Marco, where I remember Seamozzi says he himself used much of it, and infinitely commends it. Nor did they only use it in houses, but in naval architecture also; the ship mentioned by Witsen (a late Dutch writer of that useful art) to have been found not long since in the Numidian Sea, twelve fathoms under water, being chiefly built of the timber and cypress, both reduced to that induration and hardness as greatly to resist the fire and the sharpest tool; nor was anything perished of it, though it had lain above a thousand and four hundred years submerged. The decks were covered with linnen and plates of lead, fixed with nails gilt, and the entire ship, which contained thirty feet in

length, so staunch as not one drop of water had soaked into any room. Tiberius, we find, built that famous bridge to his Naumachia with this wood, and it seems to excel for beams. Doors, windows, and masts of ships resist the worm. Being driven into the ground, it is almost petrified, and will support an incredible weight; which, and its property of long resisting fire, makes Vitruvius wish they had more of it at Rome to make goists of. Where the forum of Augustus was, it seems built of it, and divers bridges by Tiberius; for that being attempted with fire, it is long in taking hold, growing only black without; and the timber of it is so exceedingly transparent, that cabans being made of the thin boards, when in the dark night they have lighted candles in them, people who are at a distance without doors would imagine the whole room to be on fire, which is pretty odd, considering there is no material so (as they pretend) unapt to kindle. The *Larix* bears polishing excellently well, and the turners abroad much desire it. Vitruvius says 'tis so pondrous that it will sink in the water. It also makes everlasting spouts, pent-houses, and featheridge, which need neither pitch or painting to preserve them, and so excellent pales, posts, rails, pediments, and props for vines, &c., to which add the palats on which our painters separate and blend their colours, and were, till the use of canvas and bed-tike came, the tables on which the great Raphael and most famous artists of the last age eternised their skill."

I have quoted Evelyn at full length, not so much

for its truthfulness or practical value, as its antiquity and curiosity, and knowing that comparatively few possess the work from which I quote (fourth edition of Evelyn's "*Silva*," 1706).*

The merits of the larch are said to have been known as early as the time of Julius Cæsar, who was born about 100 B.C., who calls it *Lignum impenetrabile*; but it is to His Grace the Duke of Athole that the credit of its practical introduction into Great Britain is mainly due.

In the "Transactions" of the Highland and Agricultural Society for 1861, Mr. Thomson, late of Dalkeith Palace, also shows to some extent the antecedents of the larch, as follows:—

"*Native Country*.—The common larch is a native of a great part of Central Europe, and forms forests in the upper regions of the Alps of France and Switzerland, at elevations of from 3000 to 6000 feet above the sea-level; when found above the latter height it is but a dwarfy scrubby bush; it is less common on the northern than on the southern slopes of the Alps; it is found on the Carpathian Mountains, and on the Tyrol

* Captain S. E. Cook says that it is spread from the South Alps to Siberia, but never grows naturally at a low level, excepting far to the north. The most southern site known to him is in the high Apennines, near their junction with the Alps in Piedmont, where there are vast and almost inaccessible forests of trees of the largest dimensions. It is common in the highest Piedmontese Alps, around Mont Rosa and Mont Blanc, and in ascending the great St. Bernard is seen far above every other tree. Authors tell us that a certain elevation of surface, coldness of climate, and inferiority of soil are necessary to produce its timber in perfection.

and Hungary. There are larches found in Russia, but they are of a different species.

"Foliation.—In early seasons this takes place in April, and when the trees are in cold valleys, by the sides of rivers or lakes, they often suffer from the effects of spring frosts.

"Defoliation.—This generally takes place in October.

"Mode of Propagation.—The seed, which is of an ovate form, and about an eighth of an inch long, should be sown in March, on light friable soil that has been well trenched and manured the autumn before. Immediately before the seed is sown, the surface of the soil should be forked over, and then raked smooth and measured into four-foot beds, with one-foot alleys betwixt them. The surface of the bed to the depth of one inch should be pushed into the alleys, with which the seed should be covered, and the whole raked smooth, and the beds finished off. Birds are apt to disturb the seed, and if nets could be spared to cover them, so much the better; but I consider a better plan is to wet the seed and rub it well with red-lead in the powdered state, which effectually prevents the birds from interfering with it. The seeds, if sound and good, may be sown at about one-fourth of an inch from each other; the young plants may remain one, two, and sometimes three years, when they are ready for their final planting out into the forest for timber trees.

"Effect in Landscape.—The larch is not generally planted by the mere landscape-gardener, yet it is capable of producing very fine effect, especially where

hill and dale abound; its fine pyramidal shape, and the beautiful tender tint of its green, with the female catkins spreading over the tree, contrasting so well with its foliage, combine to make a picture that in the early summer months the eye rests on with delight. When planted singly, which it seldom is, it forms a tree of a very different shape and character to the bare pole with a tuft of branches at its top, as seen where planted thickly; its branches descend with a fine sweep to the ground, rest upon it, and turn up again. The limb of such a tree has a peculiar picturesqueness about it.

“Average Height.”—Of forty-eight trees in the tabular abstract (see p. 222), 84 feet is the mean height,—143 feet being the highest, and 35 the lowest.

“Girth.”—The average girth of fifty-three trees, of which there are returns, is 10 feet 10 inches; the greatest girth being that of a tree at Kirkliston in Linlithgowshire, which is 22 feet 5 inches. The height of this tree is not given.

“Longevity.”—The average age of thirty-three trees in the abstract is 115 years; the greatest age being that of a tree at Old Kilpatrick, which is given at from 150 to 200 years. One of the finest trees is probably that at Inveraray, taking its age into consideration, which is only 100 years, while its height is 130 feet and its girth 10 feet.

“Soil.”—Of forty-two trees in the tabular abstract, 9 are growing on sandy loam, 3 on loamy gravel, 4 on black mould and moss, 23 on loamy and allu-

vial soils, and 3 on soil of a clayey character. The finest trees are on loamy soil in Dumbartonshire, on brown loam at Inveraray, on sandy soil at Dunblane, on the same in Kincardine, and on light alluvial soil at Dunkeld.

"Altitude above the Sea.—The mean average of five of the finest trees is 206 feet above the sea-level; taking twenty-nine of which returns are given, it is 461 feet. The highest are three trees at Crathie in Aberdeenshire, that are 1110 feet above the sea; the lowest tree in the abstract is that at Old Kilpatrick, which is only 60 feet above the sea.

"Exposure and Aspect.—Of forty-two trees, 8 have a north aspect; from north to south, 3; all quarters, 2; east-south-east, 6; south, 11; south-west, 3; south-east, 5; north-east, 1; sheltered, 3.

"Weight of Timber.—According to Hartig, larch, when green, weighs 68 lbs. 13 oz. per cubic foot; when dry, 36 lbs. 6 oz.

"Value as Timber—Trees produced on good soil have timber of a yellowish-white colour; that of those grown on cold, elevated situations and poor soil is reddish-brown and very hard. In a suitable situation the timber comes to perfection in forty years, while that of the Scottish pine takes eighty years. Charcoal made from larch is very heavy, and said to be excellent for iron foundries. The bark of the young tree is astringent, and is used for tanning leather. The objection to the wood of larch is, that it is very difficult to season, it is almost impossible to keep it from bending

and twisting, and when properly seasoned it is very hard to work, more especially to be smoothed with the plane. To remedy the evil of twisting, some steep it while in the log in water for twelve months, then take it out and dry it twelve months more before cutting it up. Steaming has also been resorted to for the same purpose. Others prefer the practice of barking the tree while standing, and then leaving it a year before it is cut down.

“ The uses to which larch timber may be applied are so numerous that only a few of them can be indicated here. The tops of the trees may be used for posts and rails, where they will last four times as long as common fir ones will. On the Tay and elsewhere it is extensively used in shipbuilding. In 1830 several thousand tons of shipping were constructed of it. The *Athole* frigate, built of it in 1818; the *Larch*, a fine brig, built by the Duke of Athole several years earlier, and many others built since these dates, have proved the larch to be as valuable timber for naval purposes as its most sanguine advocates could desire. The timber has been found to resist the effects of a tropical climate, where even the oak itself is found to shrink in the decks of ships. In many instances where the timber can be had of good quality, it has superseded all other timber for clinker-built boats. When properly seasoned, thin larch-board is at once strong, tough, durable, and extremely light. For rural purposes it is the best adapted for all outdoor fabrics exposed to wind and weather. It is, however, only adapted for

the grosser parts of such buildings, such as beams, lintels, joists, and couples."

Venice turpentine is obtained by boring the larch when it has attained its full vigour as a tree; but this ruins the timber, and it is never practised in Britain.

In the "Masque of the Queens," Ben Jonson makes a witch say—

"Yes, I have brought to help your vows,
Hornèd poppy, cypress boughs,
The fig-tree wild, which grows on tombs,
And juice which from the larch-tree comes."

The larch is not very easily transplanted when of considerable size. Sir Henry Stewart says of it in this respect: "Its roots are not disposed to become fibrous, nor is it at all patient of removal when it attains a height of from 20 to 30 feet. In this respect the *Larix pendula*, or black larch, is much to be preferred, as being a hardier tree as well as a more rapid grower."

The rot in larch wood is a disease that has up to this time baffled all the attempts of physiologists to ascertain its cause or cure, and thousands of acres of what would have been valuable timber have been ruined by it. Sang, in the "Planter's Calendar," mentions its first appearance in Fife in 1812. It had previously been referred to by Loudon in his treatises on country residences in 1808. Mr. Gorrie and Mr. Munro also referred to it in the "Quarterly Journal of Agriculture." Reports on the diseases of the larch likewise appeared in the Society's "Transactions" for

January 1847 by Mr. Pillans Newton, and for January 1863 by Mr. Morrison. The rot attacks trees in all situations and on every variety of soil, seldom appearing till the trees are from twelve to twenty years of age. It commences at the root and proceeds upward generally, but not always: sometimes it begins at the top. Our own experience of the somewhat similar disease that has attacked the vine, leads to the belief that it is caused by the spores of a fungus that enters the system of the tree through the roots and develops itself there, causing the disorganisation of the tissues wherever it enters. We should expect the decaying roots and branches of trees cut down, or the pruning of those left standing, to breed this fungus in abundance. We have known beech-mast amongst the soil of a vine border breed a fungus that entered the system of the vines and killed them, and we think the larch suffers from a similar cause.

The larch blight (*Coccus Laricus*) is a disease that was observed by the Duke of Athole in 1795. It had, however, been previously seen in old trees at Raith in Fifeshire, in 1785; and, like all insect attacks when on a large scale, nothing can be done to prevent it.

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CHAPTER III.

EARLY MODES OF CULTURE.

THREE larch trees, locally called "the mothers," were planted at the west end of the cathedral at Dunkeld, part of which now constitutes the present parish church. Mr. M'Crossy, gardener and forester to the Duke of Athole, was, it appears, a man of hasty temper, yet, moreover, one of those men whose evil deeds are so absorbed in their good qualities as to be almost lost sight of, if not forgotten. The Duke, Duchess, factor, and every one had to give way to the redoubtable M'Crossy, and with His Grace he was to the end of life a much esteemed and favoured servant. On one occasion M'Crossy mentioned to His Grace that the saw-mill at Inver, Little Dunkeld, required a new axle; and, His Grace, having at the time some friends with him, sent for M'Crossy—probably as a joke and to show him off—and requested him in their presence to cut one of the "mothers." This so enraged the veteran forester, that he made a desperate effort to strike the Duke, being only restrained by the noblemen present and the opportune shutting of the door. While thus baffled in all his efforts to strike, he made the next best of it by throwing his shoe at His Grace,

which might have done execution but for the panel of the door intervening, which received an unmistakable mark of violence. The tree, however, was cut, and it could scarcely be said whether the Duke or the forester in calm moments regretted the frolicsome and impulsive act most, for His Grace could never afterwards speak of the transaction without showing unmistakable signs of regret, and over it the forester is said to have shed many tears; and, after all, the tree is said never to have been converted into the axle for which it was cut down, but filled a higher and nobler destiny in making articles of furniture.

"The mothers" are what once constituted two of the five greenhouse plants, and the house stood near where the trees are now growing. The plants on arrival from London were in flower-pots, and were regarded as rare and tender. How long they were kept in the greenhouse is not now known, and various reasons are assigned for putting them outside. One is, that the plants appeared sickly and dying by shedding their leaves; but the other and more likely reason is, that they grew so luxuriantly and so tall that the houses could not contain them, hence the necessity of putting them outside.

* Evelyn appears to have been as badly, if not worse, served than the Duke of Athole, for he says regarding it: "The change of the colour of the old leaf made an ignorant gardener of mine eradicate as dead those which I had brought up with much care, Let this, therefore, be a warning to others."

Various and somewhat conflicting accounts are given by many authors as to the introduction and early mode of culture of the larch. Parkinson, in his "Paradisus," notices the larch to be a rare tree, and nursed up with but few, and those only lovers of variety; and Miller, in his "Dictionary," published in 1759, states that the larch had become plentiful and common in most of the English nurseries, and that of late years great numbers of the tree have been planted, adding that those that had been planted in the worst soil and situation had thriven best.

From this period the nature of the tree became better known; and as none of the fir tribe, after having begun to yield cones, seeds more abundantly than the larch, the trees spread rapidly. From the accounts we have of the introduction of the larch into Scotland, some state that it was first planted in 1725 at Dalwick in Tweeddale, and several years afterwards at Dunkeld, Menzie, and Blair, but the dates of the various reports do not exactly correspond. A report on the agriculture of Angus or Forfarshire, by the Rev James Headrick, published in 1813, says: "I saw three larch trees of extraordinary size and age in the garden near the mansion-house of Lockhart of Lee, on the northern banks of the Clyde, a few miles below Lanark. The stems and branches were so much covered with lichens that they hardly exhibited any signs of life or vegetation. The account I had of them was that they had been brought there by the celebrated Lockhart of Lee, who had been ambassador

to Oliver Cromwell at the court of France, soon after the restoration of Charles II. After Cromwell's death, thinking himself unsafe on account of having served an usurper, he retired for some time into the territories of Venice. He there observed the great use the Venetians made of larch in shipbuilding, in piling for buildings, and other purposes, and when he returned home he brought a number of larch plants in pots, with a view to try if they could gradually be made to endure the climate of Scotland. He nursed his plants in hothouses and greenhouses, sheltered from the cold, till they all died, except the three alluded to. These, in desperation, he planted in the warmest and best-sheltered part of his garden, where they attained an extraordinary height and girth."

The popular account that the trees at Dunkeld were the first larches introduced into Scotland, and that they were imported from Italy with other exotics and nursed in a hothouse, does not, from the foregoing account, appear to be correct; but as the trees at Dunkeld are now amongst the oldest and largest in the country, it is by no means surprising that, in the absence of the first imported trees, the tradition respecting their treatment should be engrafted on the celebrated trees on the banks of the Tay at Dunkeld.

Miller says the larch thrives best when planted upon an elevated situation. He notices the white and red flowering varieties, remarking that the former do not seem to be so vigorous as the latter. It is singular that, in treating of their cultivation, he should re-

commend that if any of them incline their heads downwards, to thrust a small stake into the ground, and fasten their heads upright thereto; for if they are suffered to grow on one side while young, they are rarely to be reduced to an upright figure again. "And further," he says, "you must observe to train their heads upright, and not suffer them to grow awry, which they are naturally too much inclined to do." Various conjectures are formed as to the drooping description given, but the most likely is that the plants referred to drooped because of their vigorous and succulent growth, the result of plump, full seed, and forcing, stimulating soils. I have seen young larches hang their top shoots considerably when growing very rapidly, and the foliage rich and long. The description given is more applicable to the *Cedrus Deodara* than the larch, and it is just within the bounds of possibility that some of the latter might have found their way to this country and been mistaken for the larch, to which they bear a considerable resemblance. The old accounts, however, were not in all cases fully to be relied on, not only respecting the larch, but many other things as well; and the drooping might not, after all, amount to much, and need not greatly perplex the cultivator of the present day, or influence him in his *modus operandi* of cultivation.

Evelyn says an old operose method of extracting the seeds was to cut off the scales of the cones singly and let the seeds drop out. Another and so considered improved method was to split or tear the cones into

four pieces, and then to thrash them till the seeds dropped out. Another, and at least an easier, if not a better method, was to prepare the plant bed, and to sow the cones in their whole and unbroken state, allowing nature to do the rest—which, it is needless to say, was not very satisfactory. Another system was to sow the cones thickly, or rather spread them upon the ground, and cover them with a few inches of earth, till they became tender and partially rotten, when the earth was removed, and, after lying in the sun or drying wind for a few days, were raked about, and the seed allowed to drop out, when part was allowed to remain where it was, and part removed to another bed, and covered to remain to germinate. Besides these methods, others were adopted, such as planting the cones in the ground by means of dibbles at the distances the plants would have been put in.

• Marshall says: "Let the seeds be sown in beds a quarter of an inch deep. In the spring, when the plants appear, they should be refreshed with water in dry weather, and carefully kept clean from weeds during the whole summer. By the autumn they will not have shot more than an inch or two; and in spring they should be pricked out in beds about three inches asunder. The spring following, they must be taken out of the beds with care, and planted in the nursery ground, three feet asunder in the rows, and two feet distance; and here they may remain until they are fit to be planted out finally, which will be about the second or third year after."

Evelyn says: "Abies, Picea, Pinus, Pinaster, larch, &c., all of them easily raised of the kernels and Nuts which may be gotten out of their *polysperm* and *turbinati* cones, clogs, and squams, by exposing them to the sun, or a little before the fire, or in warm water, till they begin to gape, and are ready to deliver themselves of their numerous burdens."

The ancients had great faith in the influence of the moon, and directed that all seeds be sown before the full moon; and also that cuttings of all kinds, and likewise grafting, be done during the first or second quarter of the moon. They also maintained that wood cut during the wane of the moon did not last so long in implements, &c, as that cut during the waxing moon. And it is the practice even at the present day, in some parts of the Highlands of Scotland, only to cut during the growth of the moon such trees as are desired to produce scions or copse from the stools. These are all matters little, if at all, now regarded, but there can be no harm in any one, having time and leisure at command, making proof of the theories.

Varieties.—The red-flowering larch is by some considered hardy enough to endure cold and other unfavourable circumstances, it being a native of the Alps in Switzerland; while others assert, on the contrary, that the white variety is best adapted for planting in this country, it being a native of Tyrol. This difference of opinion arises from the fact that, under certain conditions, both varieties fail or succeed. The success is not, however, due to the variety, but

to the soil, &c., in which it is favourably or unfavourably planted. The writer is prepared to point out trees of every shade of colour of flower in a sound and healthy condition, and also to show every variety in various stages of disease.

There is certainly some difference between trees whose seed is direct from Tyrol and that of home-grown larch, in their FIRST AND EARLY STAGES OF GROWTH. The difference, at least in the nursery ground, especially in the seed-bed, is at times quite obvious, and in other cases it is scarcely distinguishable.

When home-grown seed is plump and well-grown, and that from Tyrol of inferior quality, as sometimes happens, and the two sorts are sown side by side by way of experiment, and in order to compare the two sorts together, the difference is so small as scarcely to be distinguishable; while in other cases where similar trials have been made, and the seed happens to be of opposite extremes of quality, the difference is so obvious as to produce an honest impression that the varieties of larch are different. Good sound Tyrolese seed produces plants several days earlier than Swiss or Scotch seed, and the plants are admittedly more tender for some years. When the plants grow older, the marks of distinction become fainter, till at last they quite disappear; and though a good deal is said about the superiority of the Tyrolese seedlings, nothing is heard of the older trees, nor can they be pointed out in the mixed forest.

An example of this appeared in a plantation on the estate of Invercauld, Aberdeenshire, which was planted by the late Mr. Morrison, nurseryman, Elgin, in 1854. One of the conditions in the contract was to plant a certain quantity of Tyrolese plants in stated parts of the enclosure—those parts at the lower end of the plantation confronting Balmoral Castle, and about half-a-mile distant from it, and quite observable from the Deeside turnpike road. In August last the writer examined, very minutely, the larches in this plantation, now twenty-six years old, and on comparing the Tyrolese groups with those of Scotch produce, taking soil, situation, altitude, &c, into account, he left the plantation quite unable to say which had the superiority, or whether or not there was any difference between the two sorts—soil and situation making such great difference.

On viewing the plantation from the county road, three of the Tyrolese groups appear much in advance of the others, but on entering the plantation it is found that this appearance is only produced by the rising ground on which they are situated. The greater part of the larches in this plantation are in a very thriving condition, both those from foreign and home-grown seed. The only exceptions are weakly plants overgrown by stronger ones for want of thinning: such overgrown plants are black in the bark, of a sooty appearance, and soil the hands on taking hold of them. The foliage on such weakly trees is of a pale green, and covered with *Coccus Laricis*. On the

hillocks alluded to, both Scotch and Tyrolese plants are in vigorous growth, with scarcely any sickly plants amongst them; but where the larch and Scotch pine are mixed, there are many sickly plants of the former species, caused by confinement. To the writer there appears so very little difference between the Scotch and Tyrolese larch, that all practical operations of planting may be conducted as if they were one and the same. If not identical, they are closely allied, and show no appreciable difference, except during the few years they remain in the nursery, when it must be allowed there is sometimes considerable difference in appearance both in the seed-bed and also even in the transplanted nursery lines. The plants from foreign seed come earlier into leaf, and continue growing later in autumn, than the home-grown, hence are more liable to injury by frost.

CHAPTER IV.

SOILS AND SITUATIONS ADAPTED TO LARCH.

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It is of fundamental importance to know what soil and situation the larch delights in, and what are injurious to it. In the first place, the soil should be dry—that is, a free circulation of air should pass into it or through it, and no larch should be planted in soils where the air cannot freely enter, which it cannot do if water stagnates in it, or remains so long upon it that the air is excluded for any considerable length of time. Second, there must be nothing in the soil to prevent the roots from pushing and extending rapidly in all directions, and this suggests the necessity of breaking up and rendering it open, if it be naturally close, hard, and compact. Third, the soil essentially adapted to larch should contain an appreciable quantity of sand; for although pure moss, and pure clay if kept dry, will grow larch to good and useful dimensions, yet they do not bring it to the same degree of perfection,* nor does the timber remain sound to old age upon such soils. Fourth, there is no necessity for the soil being deep—three inches deep, or even less if the substrata be open: gravel, loose stones, slaty rock, or such like, suits it well. Although in some respects tender in

its young state, it is yet the hardest of our forest trees, and will not only grow, but flourish in certain soils, and at altitudes where other trees would degenerate.

The Hill of Torlum on Drummond Castle estate, in Perthshire, is 1260 feet above the level of the sea, and though affirmed to be the highest wooded hill in Scotland, it yet bears a crop of splendid larch to the extreme summit. The base of the hill consists principally of Scots pine and Norway spruce, which grow very well, but the larch alone luxuriates on the higher altitudes, growing luxuriantly at the extreme summit. The plantation was formed between 1785 and 1800 by the Lord Perth of that day, and the trees are thus between 81 and 96 years old. Many of the larches girth from 10 to 12 feet at *one* foot from the ground, and 7 to 9 feet at 5 feet from the ground; are well-grown, fine quality of timber, many of them reaching from 80 to 100 feet in height, and are in general quite sound, healthy, and vigorous.

A very remarkable example of the hardiness and tenacity of life of the larch came under my notice here the other day. On a plateau of deep moss (peat soil) some trees were being cut, and amongst others a larch, which, on being sawn at the sawmill, showed that during the first 76 years of its growth it had only made $4\frac{1}{2}$ inches diameter of wood and attained 28 feet in height. This slowness of growth was the result of other trees surrounding and confining it during the first 76 years of its life. After that time the adjacent trees had been cut down, and the small

bare pole left, probably being considered useless for anything. From the time it got room and freedom quite an amazing growth set in, and so fast did it grow, that it had made as much wood in the next 10 years as it had made during the whole of its previous existence. The layers were so small during the first 76 years as scarcely to be counted, being sometimes at the rate of 30 or less to the inch, while from 76 years on to now, when cut (109 years), it grew at the rate of an inch diameter in 2 years, or 4 zones of wood to the inch. Probably no other tree except the larch would have lingered between life and death so long, and afterwards started with a vigour equal to what is usually seen only in young trees in favourable conditions.

If any general term can express the quality of larch-producing soil, it is that adapted for growing barley. The soil adapted to larch, minus the manure and cultivation, is that which barley delights to grow in. Oak has an affinity for wheat-producing soils, and larch for that in which barley attains the highest perfection.

The larch, like all other fast-growing trees, is impatient of anything that obstructs or restrains its growth, therefore it should be carefully seen to that nothing be allowed to impede its growth in root or branch. This, however, is easier said than done, for the seasons and weather vary so greatly, that what would be conducive to health on the one side is inimical to it on the other. In a ravine, for example, where the trees grow well in a dry hot season, they sicken and lan-

guish, if they do not die, in a sunless wet one. Or again, in a dry situation, where whins, &c., have contributed to make the ground still more dry, the trees flourish and make excellent growths in a wet season, while they almost die for want of moisture in a dry one. Now, on an estate where larch is grown in both extremes of soil and situation, it is quite obvious that an extreme season, whether of drought or moisture, must prove highly injurious to the one, and equally beneficial to the other.

In 1868, memorable for its dryness, many larch trees, and even plantations, perished for want of moisture; and in 1872, memorable for its cold and wetness, plantations in ravines and damp places suffered seriously; and the results of season 1879 were much the same, or worse than those of 1872. It will therefore appear evident that extremes of wet or dry are alike inimical to larch, and therefore the mean is safest and best, which is secured by planting only on such ground where, if under bailey crop, satisfactory results might be looked for.

The larch, as already said, is also very tender in its foliage, and therefore must be grown under conditions where it is not severely exposed to adverse winds. It is also very liable to be injured by frost, and for that reason ought not to be planted in situations much exposed to it, which, by an intimate acquaintance of the district, is easily ascertained. Spring frosts are in all cases more to be dreaded and guarded against than autumn ones; indeed it is rare that autumn frosts do

much injury to the larch, and therefore it is unnecessary to take any special precautions to prevent it.

Damp situations, rather than either frosty or windy exposures, are to be avoided. The larch is a tree above all others that dislikes a shady cold damp situation, and when there is any inclination to it, the air and sunshine should be admitted as freely as possible, both by cutting down rank herbage and thinning. For this, if for no other reason, mixing larch amongst spruce or Scotch fir is objectionable, and is often the cause of failure and disappointment. The trees in their young state, from ten to twenty years, are much more easily injured, especially in the bark, than when further advanced, say from thirty to forty, and it is therefore in the young and tender state that injury from damp should be most carefully avoided. .'

The conformation and position of the ground should also be looked to. A ravine extending lengthwise from north to south is better adapted for larch than one extending from east to west. One reason is, that in the former case the soil on both sides is usually more nearly of equal quality, whereas in the latter case it is better on the one side than the other, and almost invariably on the side least exposed to the sun. Soils whose temperature varies most in cold and hot summers are least adapted to larch, and therefore such as are of an equal temperature in the growing season are to be preferred where choice can be had.

Although the larch grows at an altitude at least equal to that at which any other forest tree succeeds,

yet it is naturally less suited than some others to stand severe exposure. The larch forms its young wood later in the season than any other forest tree, often growing till the end of October, the top shoot extending upwards in some cases at the rate of nearly half-an-inch daily. It is often subjected at that season of the year to high winds, which prove injurious to the tender shoots, especially the top ones. It is often in consequence of the tender top shoot sustaining damage by high winds that plurality of tops are produced, and hence also the short trunk and broad bushy top of trees highly situated and much exposed. Severe exposure produces another bad effect upon larch, especially such as are upon the side of a hill open to the prevailing wind, by inclining them to one side. All larches thus exposed grow up with the greatest number of branches situated upon the sheltered side of the tree. If the tree is freely exposed to the south, the greatest number of branches will be upon the north side, the consequence of which is that the tree becomes bent like a bow, the *arc* being to the north, and the *chord* to the south. The pith of the tree, too, is nearest the south side, upon which side the zones or annual layers of wood are thinner than upon the north side. The cause of the difference of thickness of zones on opposite sides of the tree is caused by the additional increase of woody matter formed in the vicinity of the branches. Whatever side of a tree is most abundantly clothed with branches, upon that side the bark is furthest removed from the

pith. In order, therefore, to grow larch tall, straight, equally and duly branched all round, with the pith in the centre, and the tree proportionally developed throughout, it requires a situation where it is protected from prevailing high winds, but especially the south and west. As the prevailing winds in Scotland are from the west, larch is therefore best grown in an eastern exposure. Though there are many famous larches and larch plantations in this country upon southern exposures, yet, to say the least, there are equally good ones upon northern exposures. As samples of trees growing upon northern exposures, may be mentioned those splendid old trees at Dunkeld, Dawick House, Kippenross, Novar, Monymusk, Cullen House, &c. All the preceding, though northerly exposed, have attained at least 90 feet in height, and contain from 150 to nearly 500 cubic feet of timber. As a rule, the north side of a hill is best adapted to grow larch to age and large dimensions, while upon the south it grows more readily when newly planted, and comes sooner to maturity.

Of all the subjects connected with the cultivation and growth, &c., of larch, none have been so keenly discussed as the kind and quality of soil most suitable for it. Every person accustomed to work in soils and to examine them knows how much their properties and qualities change as he digs his way down; and though the appearance of soils upon the surface may be much alike, yet at a depth of less than twelve inches they may differ essentially. The different

layers or strata of soil may be compared to the geological formation of stratified rocks. In forming an opinion as to the cause of failure of a crop of larch, the trees are inspected, the upper surface of the ground *only* examined, and the conclusion arrived at is as often erroneous as correct.

Moss is not generally regarded as soil suitable for larch, yet the writer has seen as good larch grown upon pure moss as upon any other soil, the roots of which never penetrated either gravel, sand, or clay. This, however, requires a few words of explanation. The moss referred to was thoroughly decomposed, with no fresh fibres, as seen in common peat-moss. It had also either been dried by deep open ditches, or rendered loose and open by being turned over in the work of draining. Dryness and looseness are essential conditions, in soil termed moss, in rendering it suitable for the growth of larch. The best trees are always found upon the margins of the ditches. Upon moory soil of certain qualities larch grows well, while upon other descriptions it degenerates. An extensive larch plantation in Roxburghshire, in an elevated district, grown upon moory soil, is an illustration of both success and failure. Part of the ground bears a good crop, and part an inferior one, while some parts are quite bare. When the soil is dug up or trenched, there is little difference in the appearance of it throughout the whole plantation. The difference of growth is therefore due to the varied conditions of the soil as to compactness or firmness; and as an unvarying rule

throughout this plantation, wherever the spade enters freely, there the larch thrives well. Where the plants have failed, it is hard underneath to within a few inches of the surface. Moory soil that has been under cultivation at any time, and subsequently planted with larch, invariably disappoints the expectation of the planter. The plants grow rapidly during a few years, so long as they enjoy the influence of the cultivated soil and unexhausted manure; but the main roots of the tree *thus grown* soon decay, and it is henceforth only supported by a few minor surface roots, which at most only maintain its vitality. Meanwhile the heart-wood is contracting rot, and the whole tree gradually decays.

At the present time the writer is cutting a plantation of larch, about thirty years planted, upon soil as above described, and he finds nearly all the trees "pumped." The few exceptional sound trees are where the soil is naturally deep and the roots well to the surface.

Within the same enclosure, and similarly situated, are portions of larch planted upon the ground in its uncultivated state; and here the trees, though generally not so large as those upon the once cultivated ground, are quite sound in the heart, and, but for the hardness of the soil, I have no doubt would attain a good size and considerable age.

Moory soils are in general adapted to coniferæ, but are often compact and overlying a subsoil of "moor pan," in which case no roots will enter or go

through. What is therefore required on the part of the planter is to see that moory soils are free, loose, and open. If they are naturally so (except sand), he may safely plant; but if bound and hard, he must either break up and render them open, or forego the attempt at growing larch.

Sandy soil can probably be less improved for planting (if naturally unsuitable) than all others. Trees root well in sand; few deaths occur immediately after planting, but trees grown upon it are always, when aged (except Scotch pine), decayed in the heart-wood, and seldom attain large proportions.

Planting upon gravel is either attended with considerable success or almost total failure, just in proportion as it is loose and open, and mixed with other substances, or solid and pure shingle. Pure gravel is incapable of sustaining larch, but is a beneficial ingredient in clay, moss, and other soils, by keeping them open. Tenacious clay soils are fatal to larch, although it grows fast upon them during ten or fifteen years after planting. The flourishing state of *young* plantations upon clays often induce such soils to be planted. Loams are adapted to grow larch to the highest state of perfection; and yet as many larches have probably died (prematurely) upon loams as upon any other description of soil. Dry loams, *rather poor*, are suitable. *Damp, clayey, and rich* loams are not. It is not only necessary on the part of the planter to know the different varieties of soil by name, but also to know them practically, so that, when turned up by

the spade, he knows which are suitable and which are not.

The north of Scotland is better adapted to grow larch than the south; the reverse is the case with regard to England, the south being better than the north, owing to the soil being drier, and less moisture in the atmosphere.

The essentials of soils calculated to produce health, rapid and vigorous growth, and sustain trees till seventy or eighty years old, are briefly these:—soil dry, free, and open, to a depth of two feet; virgin soil, or soil rather poor (not exhausted by cropping); situation elevated, or freely exposed to evaporation, but protected from cutting winds while in foliage, and above the frost line.

In planting trees the future circumstances of clearing them off the ground when ripe as a crop are too seldom considered. It is well known that trees are sometimes grown in a place which it is next to impossible to take them out of, and the labour of doing so would consume the profit. Of all species of forest trees there are none so easily cleared as the larch, therefore it may be planted where no others should be. Larch, when cut and peeled, becomes very light, and when cut into short lengths, as for fencing posts, gate posts, mining props, or railway sleepers, implements, &c., it can be floated down ravines and valleys, with comparatively little water, which is usually present in the winter season in such valleys. Or where it cannot be so floated, it can, by means of block and tackle, be taken

to loading ground. Some timber is of little value when young and of small size, and cannot without loss be cut till of great age and large dimensions. With the larch, however, it is quite otherwise, for it can in many cases be as profitably cut down at forty years, and used as economically, as if grown to twice that age and of large size. Larch cut into six or eight feet lengths, although the trees were $1\frac{1}{2}$ feet in diameter, would present no serious obstacle to their removal from very steep banks or rugged valleys, at least after being peeled and dried a few days in spring or summer weather.

Since the introduction of traction engines and steam power so variously applied, the clearing of wood out of ravines is not such a formidable undertaking as it once was. I had recently an extensive lot of wood cut for an auction sale, taken out of a ravine which hitherto had baffled all efforts to do so. With one, and sometimes two engines, usually used in land cultivation, stationed on the top of the bank, and the steel ropes and appliances used in ploughing, the largest trees on the ground glided along like a sleigh, and the whole cost was considerably less than could have been done by horse-dragging on suitable ground.

- The larch in winter is as little liable to be blown down with the wind as any tree in the forest. It is known to have been grown in situations where probably no other tree would stand. It is not, however, invincible, and its history is but too sad to relate in connection with gales and hurricanes.

The season of the year at which the larch is generally most endangered by winds is in September and October, when it is most abundantly clothed with foliage. On the memorable 3d October 1860 there was an immense number of larch trees blown down all over Scotland, so much so that the market was for a time quite blocked with wood.

On the 28th December 1879 and 14th October 1881 there were severe gales, which prostrated great numbers of larch and other trees in Perthshire and adjoining counties. On His Grace the Duke of Athole's estates at Blair and Dunkeld there were, on the memorable night of the Tay Bridge accident, upwards of 80,000 trees blown down, and the same has to be recorded of many September and October gales. When, however, a gale occurs at any other season of the year, nothing especially serious is likely to take place; for although, when clothed with foliage, it is more liable than most other coniferæ to be blown down, yet when defoliated it is less liable than any others. October and March are the two months in the year in which the greatest numbers of forest trees are blown down, and therefore, though the larch is at its worst state to withstand the October or autumn blast, it is at its best to meet the vernal equinox.

When grown as a single tree, it ought to be a complete cone in its younger state of growth; but, when advanced in years, its top almost invariably becomes damaged, and ultimately it spreads and forms an irre-

gular and often fantastic canopy, a befitting subject for an oil-painting.

In the forest state, when grown in masses, it is better that the tree be considerably drawn up, after the first twenty years of its growth. By this means the trees are grown so as to bend uniformly from top to base, which is the great safeguard against blowing down. Any one who has observed the mechanical action of the fishing-rod must see that its regularly bending form is its safety against breaking, and trees to a very considerable extent may be made to resemble in their growth the shape of the fishing-rod in a modified form by regulating the thinning.

The roots of the larch should also be allowed perfect freedom to spread in all directions, and as much as possible on the surface, which, it will be observed, it always does in situations where it best succeeds, and attains greatest age and dimensions. No tree in the forest is better adapted to withstand the winter's severities than the larch; its wood, if well ripened in the preceding autumn, is as little liable to any climatic influence, or injury from the most intense frost, as any forest tree. Its buds, although they produce large fascicles of leaves in spring, in winter show very little external appearance of where they are to come from. The buds of the larch in its dormant state are very small, and well protected by the bark scales and resinous covering on all sides; so that there are always remarkably few abortive buds to be seen. On the other hand, as soon as the sap fills its vessels, and the

cambium begins to form, it is exceedingly liable to injury either from frost, cold, wet, or even a hard wind. At this stage of growth many withered branches are seen to make their appearance, and to many they are quite unaccountable, hard winds or frost not being suspected. April and May I have long regarded as the most critical season for the larch, and next to it August and September. If the two latter months are cold and wet, or the other extreme, dry and hot, the young wood is not ripened nor the alburnum properly matured; hence the unfavourable results which manifest themselves in the succeeding spring, and which often alarm and panic-strike those who do not know the cause. The difference of hardiness of the many varieties also renders the different results very perplexing. It sometimes happens that one tree will manifest a special form of disease, from which all the surrounding ones are exempt—such as blister, *Coccus Laricis*, &c.—and no one be able to assign the cause, which not unfrequently is a nip of frost or damp low temperature, at the very time the tree was most tender and unable to bear it; whereas, had the tree either been a few days later or earlier in foliating, no such disaster would have occurred. In any plant bed, nursery line, young or old plantation, the same distinctions of variety are to be seen; but as this is fully dwelt upon under another heading, nothing need be further said here.

In regard to the planting of larch as a successive crop after its own kind, Scotch pine, or other coniferæ, there are different and conflicting opinions; but it is

strongly confirmed by the most extensive and intelligent planters, that the larch plants, if properly grown, well rooted, and of small size, and the ground in all other respects suitable, the circumstance of being a successive crop, instead of a primary one, will not injuriously if at all affect the crop. But what militates most against its success is the rough herbage and want of draining; for, as a matter of fact, though perhaps difficult of explanation, ground, after having borne a crop of timber, becomes wetter after the wood is cut than it was before planting.

CHAPTER V.

PREPARING GROUND FOR PLANTING.

MUCH of the success or failure of larch culture depends upon the state and condition of the soil for receiving the plants. If the ground is naturally dry and comparatively free and clear of rank herbage, and at the same time sufficiently loose and open to a depth of about a foot, so as to admit air freely, nothing further is required than to make an opening in the ground proportionate to the size of the plant, and carefully put it in. If, however, as is more frequently the case, the ground is naturally in an improper condition for planting, something must be done artificially to make it so.

The common spade is sometimes successfully employed in turning over stony matted surfaces, where the herbage is deep-rooted and the turf thick.

The surface of the ground is in many cases of such a nature as to burn readily when dry. When this is the case, and no special inducement is held out for retaining the turf, the most advisable plan is to pare it in spring or early summer, allow it to dry, and burn it in heaps on the ground. Where the surface is too extensive, however, to admit of paring the whole sur-

face of the ground, on account of expense, the next best thing to do is to go over the ground, and by means of the common breast spade (flaughter) pare off the turf in each place where the plant is to be put in, regulating the distance from centre to centre of the pared surface according to the distance at which the trees are to be planted.

It should always be observed in planting that the stem of the plant be not buried too deep in the ground, which is unavoidable where there is a surface two or three inches thick to pass through before the rootlets enter the active soil. Again, the preservation of the lower branches from anything that would interfere with their free development is equally as important as that of allowing freedom to the roots; for it should always be borne in mind that there is a very intimate and close connection between the two, and anything that impedes the development of the one also injures the other; therefore, to place the plant in its most favourable position, its roots should be near the surface of the ground, and its lower branches in close proximity to the roots, which, in the case of small plants at least, it is impossible to do where a thick matted surface or rough herbage exists.

• Another method sometimes adopted in preparing ground for the reception of plants is that of ploughing it, and to this there is no objection if it can be properly done, which unfortunately is but rare, for the simple reason that comparatively little ground is planted on that can be ploughed.

Trenching is sometimes adopted and well thought of by some as the most perfect and commendable preparation of the ground for planting. It is not likely, however, to become a general practice, if for no other reason than the expense, which is seldom less than £8 per acre.

Manures of all kinds should be carefully avoided in plantations, and if it be found necessary at any time to plant poor moorland, it should be done with only one species of tree, as larch, Scotch pine, or spruce, so that the whole may be simultaneously cleared off when signs of decay appear. The results arising from planting arable land are in many respects unsatisfactory. The plants at first grow very rapidly, and continue doing so for a time proportionate to the depth and other conditions of the soil in which they are planted. Trees thus grown are not only themselves short-lived, but the quality of the wood is also inferior. I have seen fine-looking larch trees, containing from forty to fifty cubic feet of timber, grown upon land where the same person had reaped corn, and cut trees of the above size. The quality of the timber, however, although the trees were good in appearance, proved very inferior,—so much so, that Scotch fir posts of medium quality in the same ground have remained sounder than the larch in the form of gate posts.

There are various other means of preparing the ground which may with benefit be employed, and that can be done cheaply and to great advantage; one of the most important of these is that of burning the herbage

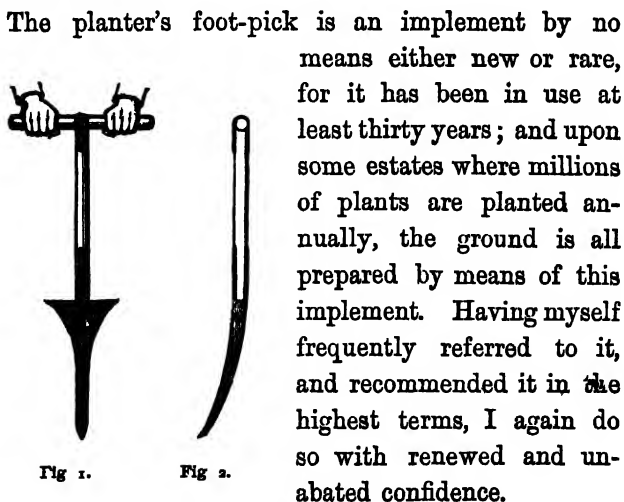
in the way commonly termed moor-burning. This by law can only be done between the 1st of November and 11th of April, and for this purpose advantage should be taken to have the ground burned when in a dry and proper state

One of the most serious obstacles to contend with in planting is that of clearing the ground of whins, and preventing them from growing up and choking the plants, for it is to be regretted that whins, whether cut or burnt, spring up and grow faster than the young plants; and it is the universal complaint that ground that produces whins, and is equally capable of producing a good crop of forest trees, seldom or never does so.

After trying various methods of growing trees amongst whins, and all of them proving less or more a failure, I am prepared to recommend the practice of line or row planting as the best. The manner of doing this is to trench, or at least clear off the whins in strips two feet broad and six feet apart, and in the trenched lines plant the trees closely in a zigzag manner at from one and a half to two feet apart. By this method the space between the rows of trees is easily cut by means of bill-hooks or short whin scythes without incurring any risk of cutting the trees, whilst the whins in the line of trees can at comparatively small expense be kept clear of them till they fairly rise above them.

Having considered the various means practicable for improving the soil and rendering it more suitable for the reception and growth of forest trees, there

remains yet one more important auxiliary for that purpose to be described. Pitting the ground, which is just partially trenching it, has been found, after long and extensive experience, to be fraught with so many objections as to be nearly out of use in the ordinary sense of forest-tree planting. The pits, in ordinary cases, are no sooner formed than they become receptacles for water; but apart from the circumstance of water actually filling the pits, the soil which fills them becomes colder and wetter than that of the surrounding unbroken ground, and whether the depressed basin-shaped surface caused by the pitting, or otherwise, chills and starves the plants, and ultimately kills them, is immaterial.



The planter's foot-pick is an implement by no means either new or rare, for it has been in use at least thirty years; and upon some estates where millions of plants are planted annually, the ground is all prepared by means of this implement. Having myself frequently referred to it, and recommended it in the highest terms, I again do so with renewed and unabated confidence.

The annexed figure will help to illustrate the implement referred to, and make it better understood

than words can do. Fig. 1 represents the foot-pick in the hands of the workman inserting it in the ground. Fig. 2 is a sectional view of the same implement. It will be observed that the dark-coloured part is iron and the light part wood. The results produced differ little from those of the common drainer's foot-pick, but the implement itself and the manner of using it differ widely in several important respects. Two men boring or loosening the ground usually prepare sufficient for one man and boy to follow planting, and as the ground thus prepared is very easily planted with ordinary-sized plants, it may be computed that a man will prepare the ground for six to eight hundred plants per day. It requires a somewhat tall and able-bodied man to use the foot-pick efficiently; but its use, like all other implements, becomes simple and easy by extensive practice. All planting upon stiff and hard moorland should be preceded by the foot-pick; its results not only prove highly beneficial in the growth of the trees, but to a very large extent prevent deaths occurring. I have said that stiff and hard moor ground should be prepared by it, but I must also add that stiff dry clay soils also derive much benefit, and ground that is naturally too wet for the successful growth of plants will, on being properly raised by means of the foot-pick, show great superiority of growth over that of ground unprepared. There is another method of preparing ground for planting which is both beneficial and practicable, such, for example, as adding clay to light moss, or sand to clay. I once saw upon the Earl

of Harrington's estate in Cheshire an excellent crop of larch, perfectly sound and healthy, growing upon what is termed "deep flow moss." The manner in which the ground had been prepared was by first cutting open ditches, and throwing the excavations upon the intervening space of ground, which served the twofold purpose of at once draining and raising it to the necessary height above the level of the water; the ground being naturally so lowly situated and level that no other means could be found for draining it. The moss, however, notwithstanding its being rendered sufficiently dry for the growth of trees, was, on account of its spongy nature, incapable of doing so without some other aid and artificial appliance, and for this end clay from some of the surrounding fields had been carted as far as horses could travel upon the moss, which, in most places, was only to its margin, from whence, by means of hand-barrows, it was conveyed all over the surface of the ground—the heaps being laid down, one barrowful to each, at an average distance of about twelve feet apart. The heaps had been neatly laid up dome-shaped by the spade, and a young larch planted in the centre of each.

CHAPTER VI.

PROPAGATION IN THE NURSERY.

As formerly stated, a London physician of the name of Gerard published a catalogue in 1596, in which he gives an accurate description of the culture of the larch; and Parkinson, a London apothecary, writing of it in 1629, describes it as a rare tree, and nursed amongst other fine varieties as an object of beauty rather than utility. Evelyn, in 1664, mentions its culture, and complains of his gardener throwing it out as dead when it lost its leaves, and regrets that it is not more cultivated. Miller, in 1731, states that the tree was common in English gardens, and the same author, in 1759, says that the larch had become plentiful and common in most of the English nurseries. His Grace, John, third Duke of Athole, previous to his death in 1774, raised about a thousand plants annually from trees grown upon the estate by his father, Duke James, and at that time all the plants he purchased from nurserymen cost sixpence each. The prices of plants have varied very greatly within the last fifty years, according to abundance or scarcity of seed, demand, &c., but the usual prices at the present time are as follows:—

One-year seedlings, 1s. 6d. to 2s. 6d. per 1000.

Two-year seedlings, 3s. 6d. to 4s. 6d. per 1000.

One-year seedlings, one year transplanted, 6s. to 7s. 6d. per thousand.

Two years transplanted plants, 9s. to 13s. per 1000.

In regard to the seed itself, it must not be gathered until quite ripe, which is not till the leaves are fully mellow and fall off; and in collecting the cones, it is well to avoid gathering them from diseased or unhealthy trees, or from very young trees; but indeed an error committed here is very speedily corrected by the seeds being unsound and unfit for sowing, which the nurseryman for his own sake tries to avoid.

Mr. Gregor, who has had ample experience of seed propagation, gives the following directions for it:—

“To extract the seeds of larch safely and speedily, the cone should be placed on a timber kiln. Brick or metal covers are unsafe, and the cones should be heated on wood. They should be laid on about six inches thick. The temperature should be raised to 100° Fah., but not above 110°. With this heat the cones will be quite dry in about ten hours, during which time they should be turned twice, and the seeds which fall out at each turning should be immediately removed. The heat may be kept at a lower degree, but in that case the time for drying will require to be extended.

“The vegetative powers of the larch seed cannot be destroyed by a degree of heat considerably higher, but even at a higher temperature very few of the seeds escape from the cones. The object, therefore, of drying

the cones is to render them brittle, preparatory to being thrashed. When dry they should be removed from the kiln in a warm state, and laid about six inches deep on a floor formed of a fine stone causeway, where they should be thrashed to pieces with flails."

After thrashing, the seeds should be dressed with a common barn fanner, which prepares them for being sown. The price of seed is generally from 2s. to 3s. per lb., and the expense of manufacturing seldom exceeds 6d. per lb. It should be sown about the end of April, if the weather be suitable, but better a fortnight later than not have the ground in proper order. The late Mr. Cameron, Uckfield Nursery, Sussex, laid it down as a rule rather to wait *three* weeks past the regular time of sowing than put the seed into ground in an unfit state for receiving it.

The best condition of soil is that which has borne a crop the previous year, and been well manured as for tares, beans, pease, &c. Fine hazel or sandy loam (but not clay) is best adapted for seed. The seed should be steeped in water before sowing, and should be dusted over with red lead, so as to give the seed a slight coating of it. This prevents the birds from eating it, which they are very liable to do, as it comes up on the top of the plant like the leek or onion, and the lead does no harm either to seed or plants.

The beds should be four feet wide, with an alley between them of fifteen inches. In sowing, 1-lb. weight should sow four lineal yards of the bed, and should produce about 14,000 to 15,000 plants, and if the crop

come up regularly and well, about two plants should be upon a square inch. The seed should be lightly covered, say about a quarter of an inch deep. The beds require very early and careful weeding, and no weeds should be allowed at any time in them to injure the plants.

The seedlings require close attention at all times, to see that they do not crowd each other, that no weeds encroach, and that no insects attack them. For catching grub, nothing is better than laying pieces of turf on the surface of the ground, when they go underneath them, and are easily collected and killed. Others recommend boring holes in the ground with a sharp, smooth dibble, as a sort of trap for them to fall into. When the plants are close in the beds, they should be thinned out at the end of the first year's growth, and transplanted into lines to remain for one year. If the plants in the beds the second year are growing too fast, stirring them up with a fine pronged steel fork partially arrests their growth, and is otherwise beneficial. Plants two years old are fit for bare moorland planting, and should never, on any account, be allowed to remain more than two years in the nursery lines without being transplanted. At three years old they are sufficiently high to stand above almost any herbage, but larger and older plants are not so safe to transplant, and it is very undesirable that a larch plant be at any time so far checked in its growth as to cause it to lose its top leader.

No plant takes to the soil more readily than a small larch does, but it is far otherwise with large

plants, unless, indeed, planted into the most congenial soils, and under favourable conditions, such as arable land in sheltered places. ●

Much has been spoken and written about the advantages of a home nursery as compared with purchasing plants from a public one. Now this is scarcely a debatable subject, for the circumstances which favour either are decided and distinct. If the public nursery is near and soil suitable, other things being equal, there can be no difference between the plants grown there and in a private nursery. For plants of a large size that require special care and culture, which nurserymen cannot usually bestow, the home nursery is preferable; but I find no special advantages that two or three year old plants possess from being grown in a home nursery instead of a public one. An argument in favour of the home nursery for all plants is used by those who believe in what is termed *acclimatising* (which I do not). I believe in the *hardening of plants*, and properly ripening in the ground, and that confinement or over sheltering, &c., is injurious, but some who advocate *acclimatising* do not after all believe much more than that.

One thing in a nursery, whether public or private, should be to have it in a good exposure, and upon soil rather light than heavy, and with a good deal of sand in it. It should slope gently towards the south or west, or be on nearly level ground. The nursery must be hare and rabbit proof, which can best be done either by a stone dyke, or by enclosing it with wire netting 5 feet high and $1\frac{1}{2}$ inch mesh, and No. 16 or 17 wire gauge.

The ground should, as far as possible, be laid off into square plots, and suitably divided with roads and walks. In lining out the plants into the nursery, one-year seedlings, to stand only one year, are put in about 10 inches line from line, and about twenty-five plants to the yard. In planting two-year-old seedlings, to stand two years in the nursery, they should stand 16 to 18 inches from line to line, and twelve to sixteen plants to the yard.

If the plants are laid by the piece, about sixpence per thousand is paid for the work, including all manual labour. Although seedlings do best on light sandy soils, yet it must be borne in mind that if it is too arid the plants become scorched and burnt up in very hot and dry weather, and when a high wind occurs, as in last May, the beds are very liable to be damaged by removal of both soil and seeds. At Forres, in Morayshire, last spring (1880), the seed-beds suffered severely by the wind blowing and removing the earth, seeds and all, thus producing the crop too thick in one place and too thin in another. Better, however, to run the risk of an occasional wind-blow than sow the seed in clay soil, which is quite unsuitable for it.

Plants are injured at a much earlier period of growth than is generally suspected. The first year in the nursery bed they not unfrequently sustain injury from over-crowding, which they never overcome. If, however, they escape the first year, they seldom altogether escape the second, if the growth is at all luxuriant. What applies to the bed applies equally to the line,

and if injured in the former, they are still more likely to be, and seriously so, in the latter. But should the plants be fortunate enough to escape altogether the injuries of the nursery, they seldom or never escape undue crowding in the forest. By these means many serious evils are entailed; and indeed when one reflects upon the unnatural and hurtful treatment the tree sustains at almost every stage of growth, the marvel is that it succeeds so well as it does.

The prices of larch plants have varied very considerably from the time of its first introduction into this country. What the first plants actually cost I have had no means of knowing, but the first plants purchased by His Grace the Duke of Athole cost sixpence each, nor is it stated that any ever cost more. As soon as the trees began to bear seed in this country the plants became plentiful, and they no doubt became correspondingly cheaper, till two-year seedlings, one year transplanted, ultimately fell to about 12s. 6d. per thousand, which has been the average price for the last fifty years. The plants, we are told, were so scarce that the Duke of Athole could only obtain, between the years 1774 and 1783, the small quantity of 279,000 plants, and two years' transplanted, as above stated, cost sixpence each. After 1780 the price fell to 35s. per thousand.

In 1843 the larch was at its lowest price known in this country, owing to superabundance and want of demand, and millions of nursery plants had to be burned, finding no market.

The market price has for many years past been very steady, partly owing, no doubt, to the railway facilities of transit, for when there is either scarcity or superabundance, the market is kept uniform, which before the time of railways was not the case.

CHAPTER VII.

PLANTING.

THE first, most extensive, and probably the best example of larch planting in Scotland was that executed upon the Duke of Athole's property in Athole and Dunkeld forests. Without detailing the whole operations, the following particulars will be found interesting and instructive:—

1. The plants used were principally two-year seedlings, and therefore comparatively small plants—small, at least compared with what are now generally planted in similar undertakings.

2. The distance between the plants was $5\frac{1}{2}$ to 6 feet, which gave them that amount of room requisite for their full growth and healthy development, and allowed each plant to make side branches at least three feet in length before touching its neighbour on either side. This also afforded the trees room for developing their roots, it being a well-established fact that the lower branches of trees and their roots extend much in the same direction, and bear similar proportions.

3. No other species of trees were mixed with the principal larch plantations, consequently no interference was made with the full and free development of

each individual tree, which in modern operations is but too seldom the case.

According to the Duke's practice, as gathered from the report to the Highland and Agricultural Society, "536,208 larches, instead of covering $95\frac{1}{2}$ acres, even at $5\frac{1}{2}$ feet apart, which gives 1440 trees to the acre, and which is the nearest distance his Lordship allowed them to be planted, would have covered $372\frac{1}{2}$ acres, which gives an excess of 277 acres. The $95\frac{1}{2}$ acres will yield at the end of seventy-two years 302 trees per imperial acre, and taking each tree at one load of timber, which is the most it will supply when planted so thick, we have 28,765 trees or loads, which, at 50s. per load, will give a money value of £71,912, 10s.; whereas, had the 536,208 larches been planted over $372\frac{1}{2}$ acres, they would have furnished 112,419 trees at seventy-two years of age, and each would have yielded sixty cubic feet of timber. The number of loads of timber would have been 134,903, which, at 50s. per load, would be worth £337,257, 10s. To this may be added the expense of thinning, and the advantages derived from the value of the grass under the trees. The magnitude of the difference in the result, arising from using the same number of larch plants in these different ways, is well worth the serious attention of the planters of larch by themselves for naval and other purposes."

In 1738 *six* larches were planted at Monzie Castle, in Perthshire, said to be of the same sample as those first planted at Dunkeld and Blair-Athole. Tradition

says the former were stolen from the carrier, who brought a quantity of larch for the Duke of Athole a few years after the now celebrated ones at Dunkeld and Blair-Athole were planted.

Between 1740 and 1750 James, second Duke of Athole, planted at Dunkeld 350 larches, and during the same period he planted at Blair 873 larches. In 1759, His Grace planted 700 larches in one plantation at Dunkeld, mixed with other trees—the last His Grace planted, having died in 1764. In 1768 John, third Duke of Athole, planted three acres all of larch at Craigvinian, near Dunkeld, at an altitude of from 500 to 600 feet, and finished the planting of 400 Scotch acres before his death in 1774. His Grace raised plants yearly to the number of 1000 from cones grown upon the trees planted by his ancestors, and the remainder of the plants he purchased from nurserymen at sixpence each, and had great difficulty in procuring them even at that price. John, fourth Duke of Athole, planted, between 1774 and 1815, 1,108,998 larch trees upon 8071 Scotch acres.

In 1829 the extent of the whole of the plantations amounted to 13,378 Scotch acres, of which 8604 were of larch alone.

On John the fourth Duke's accession in 1774, the total number of acres planted was about 1000 Scotch acres, consequently he planted about 12,378 Scotch acres, or 15,473 English statute acres. Allowing 2000 plants to each Scotch acre, it makes the number of trees 24,756,000, but in reality consider-

ably more were planted. If 10 per cent. more be allowed for making good, it brings up the total number of trees planted to 27,231,600. As the ages in each respective plantation vary considerably, they could not be marked on the following abstract; but they are distinctly enumerated in the Book of Plans, in which the number corresponds with those inserted opposite each division.

ABSTRACT OF THE DUKE OF ATHOLE'S WOODS AND FORESTS, 1829.

DIVISIONS.	Oak.	Larch.	Spruce.	Scots Fir.	Mixed.	Birch.	Total.	No. on Plan.
	ac.	ac.	ac.	ac.	ac.	ac.	Scots Acres.	No in Plan Book
Dunkeld . . .	11.763	279.997	..	207.983	195.432	..	695.175	I.
Fungarth . . .	117.958	..	..	5.663	1.834	..	125.455	II.
East Boat, &c. .	23.067	175.476	..	38	20.308	..	256.851	III.
Drumhale . . .	132	464.486	11.335	..	100.877	..	708.668	IV.
Letter and Lows	53.709	291.501	..	28.770	2	2.684	378.664	VII.
St. Columbus . .	37.106	530.139	..	..	257.544	..	825.789	X.
Guay, &c. . .	88.510	95.200	..	..	11.000	..	194.716	XVII.*
Loch Ordie . . .	20	2701.122	150	..	..	..	2961.122	XVIII.†
Loch Hoisher . .	..	2031.870	200	..	..	..	2231.870	XVII.†
Inver, &c. . .	104.196	116.103	15.474	25.036	350.284	21.613	632.706	IX.
Dalvornoch . . .	118.814	713.795	..	34	84.715	..	951.324	V.
Laighwood . . .	24.768	..	..	..	..	..	24.768	XI.
Kincraigie . . .	1.493	1.20	..	..	..	..	2.693	XII.
Kinnaird . . .	..	..	..	..	1.186	..	91.186	XIX.
Dalcapon . . .	110.158	..	..	..	94.000	..	114.158	XVI.
Tullimet . . .	78.353	161.987	..	..	..	..	240.640	XXI.
Edradour . . .	42.142	99.433	..	..	11.910	..	153.485	XIII.
Balnemoor . . .	18.450	.500	..	..	..	..	18.950	XIV.
Balnaguard . . .	..	..	..	9.500	..	..	9.500	XV.
Logierait . . .	80	253.200	..	..	..	..	333.200	XX.†
Killiehangie . .	20.263	299.503	..	..	..	..	327.766	..
Around Blair . .	..	300	..	..	1000	..	1300.000	..
Strathard . . .	..	..	..	..	800	..	800.000	..
Total . .	1070.750	8604.542	376.809	348.952	2932.096	24.297	13,378.466	

* Planted 1815 to 1818.

† Planted 1825 to 1826.

† Planted 1817 to 1819.

These plantations produced most, if not all the seed sown, and from which all the larch were raised in this country till Continental seed became an article of commerce, and from them it is roughly estimated that about 30,000,000 plants were raised annually.

In 1783 the Society in London for the Encouragement of Arts and Manufactures offered a gold medal to any person who should plant within one year 500 larches, from two to four years old, at distances from one another of five feet; and a silver medal to any person who should under the same conditions plant 300 larches. In 1788 the Bishop of Llandaff, who had by that time planted 48,500 larches in 18 imperial acres, or at distances from one another of four feet, appeared as the first claimant of the premium. In 1790 Mr. G. Wright, of Yorkshire, who had planted 11,573 larches in $3\frac{3}{4}$ acres, or at distances from one another of about 3 feet 9 inches, obtained the silver medal. In 1794 the Rev. Mr. Whittaker, of Yorkshire, who had planted 64,135 larches, of from two to four years old, on 24 acres, or at distances from one another of about four feet, obtained the gold medal. In 1798 Mr. Sneyd, of Belmont, in Staffordshire, who had planted on $5\frac{1}{2}$ acres, or at distances from one another of about $4\frac{1}{2}$ feet, 6000 larches of four years old, and 6000 of three years old, also obtained the gold medal. In 1800 J. Jones, Esq., of Hafod, in Cardiganshire, who had planted 300,000 two-year old seedling larches, at distances from one another of two feet; 85,000 one-year transplanted larches, at distances from one another of $2\frac{1}{2}$ feet; and 15,000 three-year transplanted larches, at distances from one another of $3\frac{1}{2}$ feet,—in all, 400,000 larches, on a surface of 44 acres, likewise obtained the gold medal. During the twenty-two years which followed the offer

of the medals, there were also many and important instances of the planting of larches, either as nurses to hardwood timber trees, or as permanent members of mixed plantations; and, in particular, in 1788, John Sneyd, Esq., of Belmont, in Staffordshire, planted, in a mixed manner, 6500 larches of five years old, and 6500 of four years old. In 1790, S. Milnes, Esq., between Ferrybridge and Wetherley, planted 200,000, of between two and four years old. In 1791 the same gentleman planted 145,000. In 1794, Mr. Gentrill, of Cumberland, planted 433,000. In 1802, J. Curwen, Esq., of Workington Hall, in Cumberland, planted 84,900. In eight years ending in 1803, Dr. Ainslie planted 91,800; and in 1805, Dr. White, of Butfield, planted 125,800. Thus, under the auspices of the Society for the Encouragement of Arts and Manufactures, and within twenty-two years of the date of the first offer of their medals, 1,240,008 larches were planted in England. From 1805 to 1816, mainly in consequence of such a severe blight year after year as prevented the larches from forming their cones, no candidates appeared to claim the premiums. In 1820, the Duke of Devonshire, who had planted 980,128 larches, among a total of 1,981,065* forest trees, obtained the gold medal. In more recent years, down to the present day, the planting of larch in England, principally on account of doubtful confidence in its fitness for the climate, or of ignorance as to the proper methods of managing it, has been somewhat hesitating and fitful, and by no means commensurate with either

the ascertained value of the timber or the proved adaptations of the tree. Yet much elevated land of very little value in Sussex, Hants, Kent, and other English counties remains unplanted, which could scarcely fail to yield very remunerating returns if covered with plantations, either of larch alone or of larch and other trees.

The preceding details give answer to the question why larch does not now grow where it once did. It *will* grow, under the same conditions as it ever grew, if these conditions are only attended to. Planting, it will be observed, should in general be done not closer than six feet apart, or thinned to that distance. The plants should be small when planted out, and the herbage kept bare, so as not to confine or cover them. They should be planted at a good altitude, and the soil and situation should be dry and clear of spring frosts. Now it is for those connected with larch planting to see how far they have complied with these conditions. If they have, and the larch has failed, perhaps other discoverable causes may be at work, which may or may not be preventable.

If choice can be had of the season for planting larch, I would unhesitatingly say autumn. Two conditions are necessary to be observed: *first*, that the plants are ripe, and this is known by the state of the foliage, which becomes straw-coloured when the growth is over; and *second*, that the ground be in proper order to carry on the circulation of the sap. Perhaps the latter precaution might have been with-

held, as I have never personally seen any bad^e results arise from planting in autumn, provided the plant was ripe, although the ground was somewhat dry. The growth of the larch often continues far into autumn, but nothing serious has ever happened even by planting it before the top shoot had fully ripened its foliage. The larch is very sensitive, and cannot endure being planted in a wet or cold soil. There is less risk of the plants perishing in cold soil with a northern aspect during spring than autumn; but although this calamity may be avoided for one season, it by no means follows that it may be so successfully overcome the next. Larch frequently survives the first and even second season only to die the succeeding one, therefore too much regard need not be paid to its apparent early success. All dry and sandy ground, when it would be unsafe to plant in March, should be planted in October or November. Care should be taken, as already advised, not to insert the root of the plants deep, and in order the better to avoid deep planting, the turf usually requires to be pared off.

If the ground is moorland, and the soil thin and inclined to wet, no plants over 9 to 12 inches high should be planted, and sometimes two-year seedlings are to be preferred to all others. It is the stem of the plant that suffers, even more than the roots; therefore care and pains should be taken to secure for the plantlets a congenial site and soil suitable for both.

Considering the short distances apart at which many of the English proprietors planted their larches,

compared with what the Dukes of Athole planted theirs, it is no wonder that the success of the former has been less than the latter. The wider apart the planting was done, other things being equal, the greater was the success. Notwithstanding the failure of larch in certain districts where first planted in 1795, and that every proprietor since, including the Duke of Athole, has sustained more or less loss by planting it, yet the growing of larch has uniformly continued to increase and extend throughout the kingdom. As many millions are now planted annually as there were thousands or hundreds fifty years ago.

TABLE SHOWING THE NUMBER OF PLANTS REQUIRED TO PLANT AN IMPERIAL ACRE FROM ONE FOOT TO FORTY FEET APART.

Imperial Acre.		Imperial Acre		Imperial Acre	
Distance	No.	Distance	No.	Distance	No.
1	43,560	10	435	19	120
1½	19,360	10½	395	19½	114
2	10,890	11	360	20	108
2½	6,970	11½	329	21	98
3	4,840	12	302	22	90
3½	3,556	12½	270	23	82
4	2,722	13	257	24	75
4½	2,151	13½	239	25	69
5	1,742	14	222	26	64
5½	1,440	14½	207	27	59
6	1,210	15	193	28	55
6½	1,031	15½	181	29	51
7	889	16	170	30	48
7½	774	16½	164	32	42
8	680	17	150	34	37
8½	603	17½	142	36	33
9	537	18	134	38	30
9½	482	18½	127	40	27

The number of larches planted annually must be very great, and, judging from the immense stock cleared out of the public nurseries every season, the demand must be equal to the number of plants grown.

The Bein forest of Huntly, the property of His Grace the Duke of Richmond and Gordon, is on various accounts a very important and interesting one. It comprehended 2258 imperial acres as originally planted, but with subsequent large additions it now contains not far short of 3000 acres within one fence.

Planting was commenced in March 1839, and the whole finished on 20th December the same year, at a cost of 20s. per acre. It consists principally of larch, Scotch fir, and Norway spruce, which were partly mixed and partly grouped. The Scotch fir, either alone or mixed, forms the crop on the lower ground, and larch alone that of the higher and most exposed, and constitutes about one-third of the whole extent.

The plants were put in on the lower ground about four feet apart, and on the higher about $3\frac{1}{2}$ feet apart, equal to about 3000 trees per acre. Thinning was commenced when the forest was about fifteen years planted, and has been continued till the crop upon the ground now averages about 300 trees per acre.

The part entirely composed of larch, though the poorest ground and most exposed, is yet fully a fourth more value than the other, whether mixed with larch or Scotch fir ~~alone~~, on the best soil and sheltered.

* The larches grow well to the highest peak of the hill (1050 feet altitude). Some of the best contain five to six feet of measurable timber, and are worth 6s. to 7s. each, or say £60 to £70 per acre at forty-four years' growth.

CHAPTER VIII.

MANAGEMENT FROM TIME OF PLANTING TO THINNING.

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No period of a plantation's history is of more importance, or more critical, than that which intervenes between planting and the first thinning. The most formidable and general enemies to contend with are the long grass, brackens, nettles, docks, thistles, brambles, whins, and such like. I have not mentioned heather, for it is assumed that when heath is so luxuriant as to injure the plants before they rise above it, it is burned down before planting; but if it has not been so burned, the next best thing to do is to cut it so that every plant stands quite clear of it, and will not be encroached upon till fairly above it.

In order that the plants be kept clear, they should be gone over once a year at least, and every tree set at perfect freedom, not only the top of the plant, but, which is almost as important, the side branches as well, down even to the exposure of the swell of the stem, above the roots. When the turf was not pared off preparatory to planting, the decayed grass and herbage should be thoroughly cleared away to some distance from the stem all round: this allows the

roots as well as branches to spread, and encourages their growth by keeping them in contact with the elements, which is not the case when they are buried deep down amongst wet, decayed, vegetable matter. I have frequently lifted plants one and a half to three feet high, as found growing amongst brackens or heather, and so imperfectly rooted that a four-inch flower-pot would have received them without binding almost any of the fibres. It is sometimes commendable even to set fire to and burn a larch plantation thus circumstanced, and then replant it, as thereby a better and more successful growth is afterwards attained.

Another matter to attend to at this stage is that of keeping off insects. Not very much can be done in this way, but where caterpillar exists, it may be cleared off by hand-picking, or the trees dusted over with flour of lime: this is done by first damping the tree with a watering-pan, and afterwards dusting it over with the lime while wet.

The *Coccus Laricis* is an insect which is found less or more abundantly in almost every larch plantation. Its presence indicates stagnation of growth in the trees, which is either caused by continued drought and want of moisture, or by too much wet and confinement, or by frosts in spring or early summer,—not an unfrequent occurrence in damp and sheltered situations. The former is remedied by the first copious rain and genial weather, and the latter is best prevented by thinning and giving the trees abundance of air, by

clearing off surface herbage, and anything that encourages superfluous moisture.

A species of beetle known as the curculio (*Hyllobius abietis*) attacks newly planted larch, and such as from any cause become sickly, by eating the bark; but I cannot say I ever saw them injure a truly healthy tree; and the best remedy, therefore, is to preserve as far as possible the trees at all times in good health, and this can only be done by placing them under conditions congenial to their nature and habits, which again implies much practice and experience in planting, &c.

CHAPTER IX.

THINNING.

THE next necessary work to be done is that of thinning, and it depends upon several circumstances both how and when to perform it. If planting was done thickly, thinning must be done early, and likewise if the growth is rapid, it must be done earlier than if growth had been slow.

The following are the general rules by which the writer conducts his operations of thinning, and when properly understood and attended to, will be found productive of the most satisfactory results.

Not having fixed any particular distances at which the trees should be planted, but leaving that matter to be determined by those local circumstances which cannot be specified, such as size of plantation, likelihood of deaths occurring, exposure to injury of game, &c., it cannot be said at what age thinning should be done, nor can it be said what size the trees should be when it should be commenced, nor even whether or not thinning should be proceeded with when the side branches begin to touch each other. In some cases, it is too soon to thin when the side branches begin to touch, and in others, if delayed till

then, it is too late. In a rich sheltered valley where the trees are making rapid top growths of say 30 to 36 inches annually, thinning should be done before the side branches touch, otherwise the trees will be disproportionately tall in comparison with their thickness; and on the other hand, upon an exposure with the trees far apart, it may be necessary not only to delay thinning until the side branches touch each other, but in some cases not to thin at all, either at the time the branches begin to touch and stop each others' lateral growth, or at any future period. Thinning here is not what is required, but closing together and keeping each other comfortable till the crop is ripe and ready to cut down, having attained its maximum value and perfection.

Plants, as well as animals, possess certain acknowledged points of quality to entitle them to be termed good or bad subjects, and, without enumerating or specifying them too minutely, I shall only indicate those that can be turned to general account.

A plant or young tree, then, ought to be as many feet and inches in height as it is inches in girth a little above the swell of the roots—that is, when a tree is three feet high, it ought to be three inches in girth, and if twenty feet high, it ought to be twenty inches in girth, and so on during the whole period in which it as a crop requires thinning.

In order, therefore, to maintain these proportions, due attention must be paid to thinning. If it is found that the girth is proportionally less than the height,

thinning has been too long neglected, and should at once be performed, unless, indeed, hopelessly too long delayed. And, on the other hand, if the girth is too great for the height, thinning has been carried too far, and done too severely. These are the best and safest rules I have found for the guidance of thinning operations, as applicable to all pine and fir plantations of every sort, whether whole or mixed, but are specially applicable to larch as an unmixed crop. Any attempt at perfect regularity in marking for thinning should be avoided during any of the various courses of early thinning. It is not only unnecessary, but is also impracticable. If, for example, a plantation is planted at 4 feet 9 inches apart, or say, 2000 trees per acre, when thinning is commenced, the crop could not be again regular till one from between each two trees had been taken out, thus leaving not 1000 trees per acre upon the ground, but only about 600. Though it is theoretically desirable that the trees be regularly distributed all over the ground, it is nevertheless impracticable, and any undue effort made to attain this end will result in disappointment and loss.

Neither is it necessary that the trees be all of one size. To attempt this would also be vain and fruitless; for it would imply, in the first place, that the seedling plants were all of equal strength and size in the nursery ground, and that every future influence exercised upon them was precisely of the same kind. It would also necessitate the soils upon which the plants are growing to be all alike, and of equal quality at every

stage, and of the same unvarying quality throughout, which is never the case, on even a very small area of ground, much less in an extensive plantation or forest.

Even if uniformity in size of trees were attainable, it is undesirable, for it is well known to every practical forester, and, indeed, to every one connected with wood or timber, that trees of all sizes are in request. Sometimes the largest sort is sought for, and at other times the smallest, and when neither can be found suitable, disappointment and loss are the results, because no tree could be found to properly suit the purpose.

To produce trees all of one shape and form is not to be attempted, for this implies also that the ground upon which they are grown is of one uniform quality, level or incline, and, moreover, that the same influences, and even accidents, act and bear upon the one tree as upon the other.

It has already been shown how thinning should be conducted, in order that each individual tree may sustain its own proper character and proportions of height and girth, but it has not yet been shown either how long this conical form of the tree is to be maintained, or the means to be adopted to bring about the desired change of form from the cone to the cylinder.

A young tree, which means one at that period when thinning is considered applicable and beneficial, should be of a truly conical form. Yet it is well

known to all practically connected with timber, that a conical-shaped tree is by no means the most desirable or best, but, on the contrary, that a cylindrical-shaped tree is the best form. But if in the young state the tree is conical, how can it be transformed into a cylindrical-shaped one in after years? Thinning can do it, in the following manner.

The annual layers, zones, or rings of wood upon a tree are just thick or thin in proportion to the number of branches upon the stem. If the branches are few in number and small in size, the layers will be thin; whereas if they are numerous and strong, the layers are thick. That part of the tree, too, immediately below the junction of the branch with the trunk, is enlarged by the sap elaborated in that branch, and in proportion as the branch is large or small, healthy or sickly, will the thickness of the layer be influenced. If a tree be forty feet high at the time when thinning is being discontinued and considered as no longer beneficial to the crop, and the tree clothed with branches from top to near the base, it will girth 3 feet 4 inches at or near the ground, being nearly an exact cone both in stem and outline of branches. Theory teaches this, and observation in the writer's experience confirms it. How to reduce a cone then to a cylinder is the problem for the forester to solve, and is done thus: Layer at base $\frac{4}{12}$ ths of an inch, at top $\frac{1}{12}$ th—gain, $3\frac{1}{2}$ inches diameter in forty years. As every top growth or shoot corresponds to one ring in the stem below, and every tier of branches belonging to the top

shoot adds its proportion of woody matter, to the general mass, so long, but no longer, than the branches remain vital upon the tree and perform their proper functions do the layers or zones maintain their thickness. But as soon as thinning is discontinued, and the lower branches are allowed to come so close together as to destroy their vitality, so soon does the thickness of the layers in the lower part of the tree begin to decrease. Assuming that while the branches were all vital, the layers or zones were of equal thickness throughout its whole surface from top to base, say $\frac{1}{8}$ th of an inch in thickness, five years after the lower tiers of branches had decayed by reason of confinement, the layers at base are now no longer $\frac{1}{8}$ th, but are only $\frac{1}{16}$ th of an inch thick. Again, at five years afterwards, the zones are reduced to $\frac{1}{32}$ th, while all the time the layers higher up the tree, and specially near the top branches, continue growing at the same rate as before, viz., $\frac{1}{8}$ th of an inch. Allowing, therefore, that thinning was discontinued at thirty years old, and the plantation stood to seventy years, when it was cut down as mature; and assuming that the upper part of the trunk during that forty years went on increasing at the rate of $\frac{1}{8}$ th of an inch of layer, or $\frac{1}{4}$ th of an inch diameter, and the lower part increasing only at $\frac{1}{16}$ th during the same period, how much has the upper growth gained upon the lower? or, in other words, how much nearer is the trunk to the form of a cylinder than it was forty years ago? $3\frac{1}{8}$ inches diameter.

If a tree could survive long enough, and the branches

near the top remain quite sound and healthy, the stem would be not only as thick immediately below the lowest vital branches as the base of the trunk, but, for anything to the contrary, even thicker. I have measured some trees which actually girthed more several feet up than at the base, caused in every case by large healthy branches furnishing the stems immediately below which were clear of any branches below that point.

The work of thinning not only regulates and determines the number of trees upon the ground, but it likewise determines the number and quality of the branches upon each individual tree.

The more that trees are sheltered and their tops preserved from injury by storm and tempest, the more uniform and regular will be their side branches. Trees much exposed are short in the stem, irregularly topped, bushy and spreading, all produced by the leading shoots sustaining injuries from time to time, and each time a new effort is made to regain its leader, an irregularly sized branch is produced, and more growth thereby thrown into the side branches. Those who have had an opportunity of seeing the rare old larches at Blair in Athole, or those in the wilderness at Cullen House, will observe how their tops have been injured and leaders lost several times during their growth, and the struggle they have had in attaining their present state of perfection.

On taking charge of woods, whether upon a large or small estate, it is important to know accurately every

particular before proceeding with any important operations of work. The late Earl Delaware, Buckhurst Park, Sussex, than whom few noblemen took so lively an interest in their woods, allowed his foresters on entering duty to devote several weeks in making themselves master of all details, or, in other words, to draw out a report for their own future guidance and direction. It is from practice similarly gained that the tables in this work have been constructed, and as they have proved invaluable to the writer, he hopes they may equally benefit those who peruse them. Before proceeding to explain the use of the tables and their contents, the writer would earnestly recommend those concerned to study closely and deeply every branch of arboriculture that may fall under their notice before entering on the active duties of forestry; and no better practice could well be recommended than filling blank sheets of each of the appended tables from those plantations of which they are to take the future charge.

By referring to Table No. I., p. 104, it will be seen that its general use is to form a condensed statement of all the woods upon an estate.

On the left-hand side will be found a column of figures, which are either real or supposed, according as the plantations are numbered or named. *On some estates the names of the plantations, with the dates of planting, are cast upon metal plates, and fixed upon large stones in certain conspicuous parts of the plantations—the stone and plate painted white, and the figures and letters black, which makes them easily

seen at some distance. Naming was practised to some extent upon the estate of the Marquis of Lothian in Roxburghshire, but the printing of the name is very expensive, and requires a large plate for the purpose, so that if any remarks are to be made relative to the plantation, the number is all that is required to lead to all other particulars. Plates 7 inches by 5, of an oval shape, are sufficiently large to contain three figures, and few estates contain over that number of separate plantations.

Column 2 contains the name of the plantation as taken from the plan of the estate. It is partly with a view of checking mistakes that the number ought to be put along with the name, for while they have several uses in common, they have each also special ones.

Column 3 contains the date of planting; and as the annual growth of the plantation is always an important item in all calculations upon plantations, it is necessary to state the month, to show whether planted in spring or autumn. For example, No. 1 was planted in autumn 1826, therefore season 1827 was its first growth; and No. 2 was planted in spring 1844, consequently its first growth was of the same year, but not likely so great.

Column 4 contains the area of each plantation in acres, roods, and poles, which in all advanced plantations is usually obtainable from the plan of the estate. The importance of knowing the extent and contents of each plantation is so well known as to

explain itself; and without such data very serious errors are frequently committed.

Column 6 contains the number of each class or species of trees in each plantation, and on comparing any class (as oak) of any individual plantation thinned after date of report, it can be seen at once how many trees of that class still remain in the plantation. The advantages of the classification and arrangement thus shown are very great, as it enables the proprietor or forester to know at any time the exact number of each species of tree in the plantation, or upon the whole estate.

Column 7 contains the total number of trees in each plantation, and the total number of what is upon the whole estate is shown at the bottom of the column.

Column 8 contains the total value of each plantation, whether as mature and fit for cutting down, or young and growing, and valuable only as a standing crop.

Column 9 contains the average annual growth each plantation is making. In some plantations, as young pine and fir, the growth is given in lineal feet; sparwood trees are also computed in the same manner. Timber-sized trees of all sorts are computed by the cubic foot; and beech, birch, alder, &c., suitable only for burnwood, by the ton, load, or cord.

Column 10 contains the money value per acre of the annual growth or produce of each plantation. Pit props are computed at about 1s. 10d. per 72 lineal feet; a larger size of trees, fit for crown props,

at 3s. per 72 lineal feet; and a still larger size, termed sparwood, at 6s. per 72 feet lineal. Pine and fir timber size trees are calculated at 6d. per foot up to 9d. per foot cubic; larch about one-fourth to one-third higher—both per lineal and cubic foot. Beech is calculated at 8s. to 10s. per ton, and birch, alder, &c., at 6s. per ton. The above are the prices which the proprietor should receive, without any expense upon it, or as it stands in the wood.

Column 11 contains the transferable value per acre, which, in some cases, as Nos. 20 and 21, is the same as the prospective value, arising from the circumstance that, after plantations arrive at full maturity, there is a certain loss going on by some trees decaying and others breaking or being blown down with the wind. To the value of the growth of the wood of all plantations below thirty years old, or those of which the thinnings have not yet paid the original outlay of forming the plantation, such cost per acre is added; but to plantations which have been thinned to that extent no such addition is made.

Column 12 contains the prospective value, which is the highest that it is estimated the plantation is capable of ever attaining, or at least that stage of growth at which it pays the proprietor best to cut it down and clear it.

Before leaving the tables, it may be proper to explain still further how the various data in Table I. are obtained, in order to know the exact number of trees upon the ground.

A book ruled horizontally, but not vertically, which can best be done on the spot, and the assistance of two men with a tape line, are all that is required. Thus provided, a line through the longest part of the plantation is decided upon, when one man, line in hand, goes up to the nearest tree and calls out the species, holding the end of the line to the tree till the other states the distance from it to the fence where he stands. The first man now girths the tree at about four feet from the ground, calls out the girth in inches and height in feet, and walks up to the next nearest, *zigzagging* the line from tree to tree throughout the whole run; meanwhile the valuator follows up closely, marking as he proceeds, of which the following is an example:—

Species.	Distance Apart.	Height.	Girth.
P. . . .	10	16	15
L. . . .	14	15	20
Sp. . . .	18	14	16
Bir. . . .	15	16	14
Pop. . . .	13	16	18
A. . . .	...	...	...
Al. . . .	..	...	...
Li. . . .	...	...	...
W. . . .	...	...	...
O. . . .	...	...	...
E. . . .	...	...	...
B. . . .	...	...	...

P. is for Scotch pine, L. for larch, Sp. for spruce, Bir. for birch, Pop. for poplar, A. for ash, Al. for alder, Li. lime tree, W. willow, O. oak, E. elm, B. beech, &c.

When the extremity of the plantation is reached other lines are required to be taken, if the crop is

irregular upon the ground, in order to intersect as many of the good and inferior parts as possible, with a view of arriving at the various averages, which is essential in order to arrive at an exact estimate.

It has been stated that the trees are girthed at four feet from the ground, the girth at which height, including bark, is about equal to the girth at the base without it, or below the bark, which is a simple way, and sufficiently correct, as making allowance for bark. A common way of finding the average of a plantation is to select patches of one-fourth of an acre in several places, the best and worst parts, and count the trees upon them. The objection to this practice is, that it does not show how much good and how much inferior crop there is upon the ground, and therefore leads to error.

The mode of valuing above described applies only to one class of plantations, namely, such as have been at least once thinned, but are below timber size. In valuing plantations that have not been thinned the first time, the practice pursued by the writer is to go carefully through every part, and note the length of the last matured top growths, and also the full height of the trees, to the extent of about 800 to the acre—the number that should remain on the ground after being thinned the first time. The method of casting-up the value of a young plantation is a question of simple proportion, stated thus:—If a plantation of sixty years' growth is worth £30 per acre, what should the value of the same plantation be when only forty

years old? Answer, £20 per acre. Or, if a plantation sixty years old is worth £30 per acre, what should its worth per acre be at ten years? Answer, £5 + £3 for original outlay in planting = £8.

To explain still further this important branch of forestry, it may be stated that it is only to plantations about or below thirty years old that the original cost of forming is added, and that plantations above thirty years planted, or such as are sufficiently thinned, are valued simply according to their prospective value. For, though no further benefit could be derived from thinning, yet the advanced state of the trees admits of grazing the plantation (which was not the case in its younger state), and this is often of more value than the thinnings themselves are. The practice of valuing young plantations as here described is objected to on the following grounds—no interest being allowed upon the original outlay, and no item put in to represent the rent of the ground. To these the reply is, that both interest upon outlay and rent are included in the *one item*, the value of the *annual growth*, of which the following is an example:—The value of the annual growth of a plantation is, say, 10s. per acre, ground rent 5s. per acre, and original cost of planting 60s. per acre—amounting altogether, at five per cent. simple interest, to 8s., which is the real annual cost; to meet which there is 10s., the value of the annual growth, thus leaving a balance of 2s. per acre in favour of planting.

It depends upon the annual growth of the planta-

tion whether the investment shall be profitable or otherwise; and as the interest upon the original outlay is so important an item, great judgment and economy are required in forming young plantations.

There are several ways of valuing mature or full-grown plantations, which may all prove sufficiently correct; but the following appears to the writer the most commendable:—If the subject is purely a fir or larch plantation, the whole is put down in feet; but if the plantation is a mixed one, consisting of a great variety of trees, the following is the simplest and best mode:—Every tree is marked in some way, if to stand uncut, with chalk, which is quite sufficient, and soon washes off with the rain without disfigurement; but if to be cut down, the bark should be removed with a marking axe, and a number put on in any way found convenient. The following is the form in which the valuator's book is filled up in valuing a general mixed plantation:—

	s.	d.		s.	d.
O	30	0	Sp	20	0
A	25	0	S P	15	0
E	20	0	B	20	6
S C	30	0	Bir	10	0
L	20	0	Bee	5	6
Li	40	0			

O is for oak, worth 30s. the tree; A, ash, value 25s.; E, elm, worth 20s.; S C, sweet chestnut, value 30s.; L, larch, value 20s.; and so on with all the others. After reaching home the whole is arranged and classified, and each species of tree put in a column by itself,

In valuing old or mature plantations, the following is the practice I pursue:—I provide myself with a foot-rule, graduated leather strap, a pole, marking axe, and red-lead pencil. The strap is from 15 to 20 feet long, and $\frac{3}{4}$ -inch broad, and is best when made out of a seasoned gig rein. Such straps are not to be bought, but must be home-made and marked as in the annexed figure.

Lead	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
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The pole is used for taking the height of the tree at 14 feet up, and the strap for showing the girth or side of the square. By this simple method, the contents of the tree are ascertained almost at a glance. A few examples will show how this is done. Taking the section of the tree at 12 feet, the following are the results, sufficiently near for all practical purposes:—

12 ft. long, 6 in side of square, $\frac{1}{4}$ of length, 3 ft. 0 in true contents.

12	"	7	"	$\frac{1}{4}$	"	4	"	1	"	"
12	"	8	"	$\frac{1}{2}$	"	6	"	3	"	"
12	"	10	"	$\frac{3}{4}$	"	8	"	4	"	"
12	"	12	"	1	"	12	"	0	"	"
12	"	14	"	$1\frac{1}{4}$	"	16	"	4	"	"
12	"	15	"	$1\frac{1}{2}$	"	18	"	9	"	"
12	"	17	"	Double	"	24	"	1	"	"
12	"	21	"	Triple	"	36	"	9	"	"
12	"	24	"	Quadruple	"	48	"	7	"	"

The relative proportions are easily remembered, which greatly assist the measurer in arriving at the contents of a tree. The intermediate figures also soon become familiar to the mind when extensively used in practice. If the wood is all of one kind, as larch, spruce, Scotch

pine, oak, &c., with the assistance of two men—the one to girth the trees, and the other to put a number or mark upon them, the valuator enters the contents of each tree in feet, in one column only, and afterwards casts up the contents and value at a given rate per foot. But if the plantation is composed of different species of trees, the whole is sometimes entered as money, and not feet, with the initial letter of the name for the sake of brevity. Thus:—

	s.	d.		s.	d.
L	25	0	O	20	0
S P	10	6	E	30	0
Sp	12	6	B	35	0

L means larch, worth 25s.; S P, Scotch pine, value 10s. 6d.; Sp, spruce, worth 12s. 6d.; O, oak, value 20s.; and E, elm, value 30s.; B, Birch, 35s. The putting down of the money value instead of the number of feet is by some thought objectionable, but in the writer's experience it is freer from objections than any other system, because many trees, irrespective of their real measurement or contents, are of high or low value. An ash, for example, may be worth 30s., while another of equal cubical contents may not be worth 20s. A clean, well-grown larch of 20 cubic feet may be worth 30s., while another of the same species, measuring even more, may not be worth half that amount.

In valuing pine or fir timber, where the rule is to put it down in feet and cast up the value in that way, there is the same difficulty to meet in showing the true value of fine-grown and rough-grown wood

classed together, so that in either case the practice of putting down the money value instead of the contents of the tree has much in its favour, and may with confidence be practised as a true and correct system.

It is not presumed that the accompanying tables are in every respect so complete or perfect as to meet every requirement or emergency that may occur. To do this would necessitate a great many more tables, and a still greater number of columns, which would disconcert the forester, if not entirely discourage him at the very appearance of a task so formidable, and prevent even an effort being made to keep or fill them. It is with a view to save time and labour in writing that the tables have been constructed, and at the same time to show in a clear manner most of what is required in practical forestry, the showing of which should contribute greatly to increase the general interest in forestry by proprietors. Presuming that the tables, so far as necessary, explain their own object, we shall now return to them, beginning with Table No. I., and describe briefly such of the plantations as appear sufficiently interesting and instructive, passing over with only a glance those of less interest.

No. 1 is what is termed a mixed fir plantation, being composed principally of Scotch pine, with a small mixture of larch and Norway spruce, and a few hardwoods—chiefly ash, elm, and sycamore—on the margin; the hardwoods of either class, not amounting to one per acre, are classed in the table as “various.”

The plantation was formed in 1826, as shown in the table, and contains in round numbers sixty-three acres. At date of report it contained an average of 290 trees per acre, namely, 266 Scotch pine, 12 larch, 4 spruce, and 8 various. The value of the whole plantation was £1044. Its state of growth was fair, making annually 17s. per acre. The transferable value was £16 per acre, and prospective value when sixty years old £26 per acre. This plantation having been several times thinned, and now fifty-four years old, is understood to have repaid the original cost, hence in making up the transferable value no allowance is made for such outlay, but the value computed at the true rate of growth.

By referring to Table No. III. (thinnings), it will be found that No. 1 was thinned in 1870, and that 3720 trees were cut and sold by auction, which realised £108, 5s. 6d. The cutting, lotting, and preparing for sale cost £23, 6s. 1d., and expenses of sale itself about £5.

Drains.—It will be seen by referring to Table No. V. that there are 7860 yards of open surface drains much grown up, which require cleaning out and deepening.

Fencing.—There are 3432 yards of turf dyke on the plantation in a broken-down and fenceless condition, which was well repaired in 1870, by making up all gaps in the dyke, and erecting a three-wire fence on top, with larch posts, and iron strainers, and winding brackets, for the sum of £100, 2s.

Roads.—By referring to Table VI., it will be seen there are 1290 yards of road, rough on the surface, requiring repairs; and in 1870 the repairs were executed at a cost of £5 sterling.

The plantation for several years past was let for grazing purposes at the annual rent of £5, but since enclosing, it is now let at £11, thus giving 6 per cent. for enclosing, which, besides being sufficient to maintain the fence, adds a little to the revenue of the estate.

It will be seen that the highest attainable value of this plantation is estimated at only £26 per acre, a small sum for a plantation making its annual growth at the rate of 17s. per acre. This is explained by the circumstance of a considerable number of deaths occurring yearly, and especially by the larch decaying on the wet clay soil.

No. 2 is another mixed fir plantation, planted in 1844, containing forty-one acres, and was the subject of a report in the Highland and Agricultural Society in 1870, which shows the following statement: 345 Scotch pine, 50 larch, and 5 spruce = 400 trees per acre. The market value of the whole crop is £326; average annual growth, 300 lineal feet per acre, value, 12s. 6d; transferable value, £8 per acre; and prospective value when sixty years old, £29, 5s.

Drains.—This plantation was originally drained to the extent of 3500 yards, but the drains were too shallow for the limited fall, hence are now found insufficient as to depth, and much in want of cleaning throughout.

No. 3, planted in 1835, contains thirty-seven acres, and is composed of the following species of trees, viz., 126 Scotch pine, 41 larch, 42 ash, 4 oak, 2 elm, 20 spruce, and 15 various = 250 trees per acre, and is worth in the market £563, 10s. The present annual growth is 63 cubic feet, worth 25s. The growth is computed at timber rate, which is rather more than appears in the column, but the discrepancy is in consequence of a considerable number of trees decaying annually—a circumstance always necessary to be taken into account in valuing and reporting. The transferable value is put at £15 per acre, based exclusively upon the present growth of the trees; and prospective value, £43, its maximum attainable value at sixty years' growth.

By referring to Table III., it will be seen that in 1869 there were thinned out 3837 trees in all, which, like No. 1, were sold by auction, and realised £158, 10s.; cutting and preparing the wood for sale, £20, 19s.

Fences.—No. 4 shows the length of the fence to be 2719 yards in extent, and its state and condition dilapidated and worthless, and much in need of repair. During the year of report, it will be seen that a three-wire fence was erected along the dyke top similar to that of No. 1, at a cost of £67, 14s. 6d., including labour and materials.

Drains.—Table V. shows there were 7860 yards of surface drains in the plantation, all choked and requiring cleaning out, and which, as shown, was executed at a cost of £11, 14s.

Roads.—The roads, which are not metalled, but only brought into form by throwing the earth out of the drains cut alongside them into the centre, were much broken up and filled with water. These, to the extent of 1980 yards, were repaired in 1869 for the sum of £7, 10s.

This is a very excellent plantation, and most of the ground quite dry, so that cattle produce no bad effects upon the trees. Horses are excluded, on account of the hardwoods in the lower end of it, which they would peel and destroy, but sheep are allowed to graze at all seasons.

No. 4 is a mixed fir plantation, planted in 1843, and was the subject of a report to the Highland Society in 1847, or rather published in the July number of the "Transactions" of that date. It contains seventy-two acres, each on an average containing 360 trees, distributed thus: 338 Scotch pine, 20 larch, and 2 spruce. It is worth altogether £745, making 300 lineal feet annually per acre, value, 12s. 6d. The transferable value is £10, 7s, being £7, 7s. for growth, and £3 added for original outlay. The prospective value at sixty years' growth is £23 per acre. The number of trees per acre may appear small when it is seen that the plantation has been very little thinned, but this is owing to large patches being quite destitute of trees, having been killed by wet and moor-pan.

No. 5 is a mixed fir plantation, planted in 1837, and contains in round numbers fourteen acres. At date of survey in 1868, it contained 330 trees per

acre, namely, 282 Scotch pine, 41 larch, 2 spruce, and 2 various, and was worth altogether £128, 5s. The annual top growth per acre was 247 lineal feet, worth 27s., transferable value £9 per acre, and prospective value at sixty years' growth, £56, 11s. The transferable value in this case is less than that of No. 4, owing to having been thinned to the extent of what would at least pay the original outlay. The plantation was systematically thinned in 1869 to the extent of 800 trees, which realised by auction £15, equal to about 4½d. each, and cost in cutting, lotting, &c., 40s.

Fence.—The fence, originally turf with whin hedge, is now done up with a three-wire fence on top, 1122 yards in extent, and cost £20, 5s., including materials and labour.

Drains.—The drains, 800 yards in extent, were, after thinning the plantation, duly cleaned out, which cost 24s.

Roads.—There is only one road through the plantation, about 400 yards in length, which, owing to the hard quality of the soil and small traffic upon it, has required no repairs.

This is one of the best and most thriving plantations upon the estate, and having been uniformly well managed, is likely to pay well. In addition to the annual growth being worth 27s. per acre, the plantation is let for grazing of sheep or cattle at 70s. per annum.

No. 6 is a mixed fir plantation, planted in 1837, and contains twenty-eight acres. Like most of the

plantations in this district, the soil is too clayey for producing good quality of Scotch pine, and unless drained, and even ridged, is no better adapted for larch; but the herbage being rank in places where the trees have decayed, renders the plantation good for grazing, for which it is let at £8 per annum.

No. 8 is a young and promising plantation, composed of larch and Scotch pine, at the rate of 496 larch and 1249 Scotch pine per acre. The larch are on an average fully $4\frac{1}{2}$ feet high, while the Scotch pine are scarcely yet two feet, a circumstance quite common at an altitude of about 800 feet, thoroughly exposed to the sea, and inland only about three miles.

No. 9 is a narrow belt of old plantation, extending along the north-west side of No. 8, and preserved to shelter the latter till the plants become fairly established. This belt is about fifty-six years old, and comprises a variety of trees, which, though probably not planted with that object, yet fully shows those best and those least adapted for such situations. The following is the order in which they stand in the valuation book:—Alder, worth 3d. each; ash, 4d.; oak, 6d.; birch, 2d.; beech, 3d.; sycamore, 3d.; spruce, 4d.; Scotch pine, 7d.; and larch, 1s. It is worthy of remark that the exposure is one of the most severe, while the soil is of the worst description; and all the trees, especially the Scotch pine, are excessively twisted and crooked, and on that account alone are nearly valueless. Many of the larch are also crooked, but for boat-building this is rather an advantage than

otherwise, and being of super-excellent quality, is much prized for that purpose.

No. 10 is a mixed crop of larch and Scotch pine, succeeding one of pine. It was planted in 1858, and comprises $36\frac{1}{2}$ acres. It was thinned for the first time during the past summer, but the inferior trees only being cut, no money could be got for them; and the work of thinning, which was performed with handbills, cost about 5s. per acre, thus adding, as it were, that amount to the cost of planting, &c.

On valuing the crop after being thinned out, the following are the results:—Larch, 317, Scotch pine, 270, and 2 beech—equal to 589 trees in all per acre. Top growth, 500 lineal feet per acre, value 20s. Value of the whole plantation, £326, 5s. Transferable value, £5, and prospective value at sixty years' growth, £35 per acre.

No. 11 is an extensive mixed fir plantation, on the summit of a high hill, some parts of which are thriving remarkably well, and others upon pan remain only stunted bushes. An old roadway through one of those zones of pan had at one time been carted upon and broken up with the cart-wheels. This roadway presents all the appearance of a trenched belt, the trees being well grown upon it and healthy, thus showing the necessity of breaking the moor-pan previous to planting. The crop of wood on the roadway is worth £20 per acre, while that on each side of it is not worth a shilling.

No. 12 is remarkable only on account of the comparative failure of the Scotch pine and larch, and complete success of the silver fir, which latter had been planted about twenty years after the original crop. The exposure is severe and soil cold and damp—conditions congenial to the silver fir, but adverse to the other trees.

No. 13 is worthy of special notice on account of the spruce confining the hardwoods and preventing them from branching, and the more they are thinned out they only spread their branches the farther and extend the damage wider. The spruces themselves are rough and superabundantly clothed with branches, while the state of the hardwoods is the reverse, which shows they should never be grown among spruce, and seldom amongst coniferæ of any kind.

No. 14 is a mixed hardwood plantation in a deep ravine. It is not mixed with pines or firs of any sort, and is exceedingly healthy. The ash and elm are of about equal value, namely 2s. each. This portion of hardwood plantation might well be taken as a model after which to grow hardwood successfully.

No. 16. This is a ravine with a narrow portion of table-land planted at top, which shows very forcibly how well larch delights in freedom and air, for the trees on the top are much superior in every respect to those below in the glen. It is not, however, to be overlooked that this ravine, like many others, is rather damp for larch; even the sloping banks are too wet and cold—a

circumstance quite common, but often overlooked on sloping banks.

No. 17. This plantation, save that it is larger, is in almost every respect similar to No. 16. It is, however, slightly mixed with gean, which had better be cut out early, as the fruit is too tempting for children to resist; hence they invariably destroy the trees, which is deeply to be regretted, as few trees are either more profitable or ornamental than the gean tree.

No. 18 is remarkable only for the whins, which contend for the mastery over the trees, and are very difficult to subdue. Probably the best thing to do amongst whins is to plant the trees in rows six feet apart, and cut them at midsummer for a few years till the trees overshadow and kill them.

No. 19 This plantation is remarkable for the equal growth of the trees and uniformity of crop over all parts of the ground. It is composed chiefly of larch and Scotch pine, has been once thinned, and bids fair for an excellent crop both of larch and pine, which occupy the ground as follows:—Larch, 481; Scotch pine, 258; various, 31 = 700. The average number of trees per acre here is greater than in any of the other plantations that have been thinned, which is partly owing to absence of roads, partly to the plantation having been only partially thinned, and partly to the very regular state of the crop all over, which shows the trees to be little less than eight feet apart.

No. 20. This is a plantation about eighty years old, originally planted chiefly with beech, with a small mixture of oak and other trees. Having been repeatedly thinned out, as occasion required, it no longer bears a profitable crop, and is now about to be cut, save the oak and a few trees left for ornament. No other trees answer better than oak to mix with larch or ash, as it usually requires double the time of either of them to attain maturity; and may, therefore, very properly be left to mature, while larch, ash, elm, poplar, and some other description of crop are progressing, which, when mature, may be either all cut at once, or another series of oak might be left like the first, and the same process repeated continuously.

No. 21 is also an old plantation, and it is proposed to treat it in a manner similar to No. 20. Both this and the former plantation, it will be seen, show the transferable and prospective value alike, which implies that they are considered as not improving further, or at least that the decay of one class of trees counterbalances the progress and increase of the other.

No. 22 is a narrow hardwood belt sloping to the sea, and the nearest part distant from it only a few yards. It is composed of a variety of trees, the best of which is the sycamore, which stands the sea exposure better than any other.

No. 23. This is an old and narrow belt, composed chiefly of beech, which, at the time of planting, was at least twice its present price per foot; but now, save

the trunks of clean growth, little of it is used, except for fuel and shchuring, for which purposes from 10s. to 12s. per ton is given in the wood, or 20s. delivered.

No. 24 is a mixed, or rather grouped plantation, about seventy-five years old, and has been cut from during several years, to the extent of about one-half of the crop, so that what is here reported upon is about half of what should have occupied the ground, and shows very conclusively the great advantage of a grouped crop of trees over that of a general mixed one.

The inducements to construct the annexed tables were to save time and labour in putting down such particulars as are necessary to be shown, and at the same time to avoid the necessity of entering upon calculations—to many a dreaded task. It is not presumed that the tables are perfect, or that they embrace every particular, for to make them so would practically put them into disuse, as scarcely any forester would be induced to use them. But in their present form they are at least so simple, and require so little time to keep them posted, that no one who keeps accounts at all would think it any undue labour to use them; and less than five years would satisfy any one that the labour was well bestowed.

The auction sales book referred to is not shown, as its use is so simple that one line might explain it. It shows the number of lots sold, the purchasers' names,

sum and amount paid or realised at sale, the plantation or district of sale, the total number of trees, and number of each species; these and other details are shown in an abstract form.

It should also be mentioned that certain descriptions of wood are neither sold directly by private contract nor by auction sale, but sent to the estate sawmill for manufacture; and as this branch of business is apt to mix, as it were, a wholesale and retail trade together, it is better to charge all the wood, in the first place, against the sawmill, show where it grew and what it realised, with the manufactured or other wood disposed of at the sawmill entered in a special way against each department or respective party.

The practice of deadwooding means simply to prune off close by the trunk all dead or decaying stumps or branches, especially in plantations about to be pastured by sheep or cattle.

Pruning of hardwood requires profound skill, sound judgment, and a practical hand; without such no one should prune; better far no pruning at all than such as often meets and offends the eye in many places, not to speak of the evils entailed upon the trees.

Whins are, probably, next to rabbits, the greatest evil foresters have to contend with; and it cannot be too strongly urged to keep them down till the trees obtain the ascendancy over them, which they generally do in four or five years.

It is recommended, in describing Nos. 20, 21, to leave the oaks to mature while a second crop is growing up, and cut them along with the second, and not the first crop. Amongst others, one reason for doing so is that few proprietors like to see a whole plantation swept entirely out of the landscape; and another is, that to cut old and large trees in the midst of young ones is destructive, and bad forestry: hence, to overcome these difficulties, oak is left, which requires longer time than any other trees to mature, and its branches bear pruning or lightening, which they often require to some extent for the sake of the young and rising crop around them.

It is of no small convenience to every manager of woods to have in a large book-form a sketch or outline of every plantation under his charge, which should have the contents and measurement of the fences marked upon it, gates shown, also roads, burns, and bridges. This is soon and cheaply done by means of tracing paper, taking the outline from the estate plan or survey, and transferring the same to a book bound for the purpose, of good quality of paper or oil-cloth.

TABLE No. L—

Number of Plantations.	Name of Plantation as on the Map of Forest Reserve.	Date of Planting.	Contents of each Plantation.	Date of Report.	Average Number of each Species of Tree per Acre.									
No.	Name.	Year.		Year.	Oak	Ash	Elm.	Beech.	Sycamore.	Scotch Fir.	Larch.	Surface and Silver Fir.	Various.	
1	A . .	1826	20 10 20 65 1 16	1869	..	..	..	..	..	266	12	4	8
2	B . .	1844	40 3 32	1870		..	.	..	..	345	50	5	..
3	C . .	1835	37 0 2	1868	4	42	2	..	..	126	41	20	15
4	D . .	1843	72 0 26	1870	.	.	.	..	..	338	20	2	..
5	E . .	1837	14 1 7	1868	.	..	..	..	..	282	41	2	5
6	F . .	1837	28 0 0	1870		..	..	..	..	251	80	..	25
7	G . .	1847	6 1 12	1870				.	..	149	236	3	2	
8	H . .	1860	276 1 17	1870			.	..	..	1249	496	5	..
9	I . .	1810	31 3 26	1870	2	3	..	1	..	64	29	..	16	
10	J . .	1858	36 1 37	1870	..	..	..	2	..	270	317	10	1
11	K . .	1847	333 1 15	1870	..	..	.	..	..	256	74	..	11
12	L . .	1838	7 1 8	1870			..	..	..	561	56	63	..
13	M . .	1839	7 2 0	1870	10	94	101	..	..	..	..	92	3
14	N . .	1861	2 2 4	1870	58	58	58	.	..	..	426	80	..
15	O . .	1839	2 3 2	1870	..	127	87	..	..	48	54	31	13
16	P . .	1856	2 2 6	1870	2	4	4	..	..	..	868	..	1
17	Q . .	1857	7 0 26	1870	1	..	.	.	..	..	1198	1	..
18	R . .	1852	4 0 12	1870	..	.	..	..	..	457	160	23	..
19	S . .	1846	13 3 33	1870	..	..	..	..	..	481	258	31	..
20	T . .	Old	8 3 8	1870	12	2	..	16	2	1	2	..	6	
21	U . .	Old	5 1 30	1870	6		10	32	..	11	7	..	6	
22	V . .	1836	6 0 15	1868	..	35	124	..	96	..	14	..	39	
23	W . .	Old	8 0 29	1867	1	2	1	30	..	..	..	..	4
24	X . .	Old	24 3 31	1868	.	1	1	2	..	107	5	..	21	

REPORT.

Total Average Number per Acre.	Total Value per Acre at Date.			Average Rate of Annual Growth at Date per Acre		Value of Annual Growth per Acre.	Transferable Value per Acre at Date.		Prospective Value per Acre at Date.	
Trees				Year	Growth		Year	Value	Year	Value
#	\$	s	d			\$		\$	s	d
290	204	0	0	1869	192 lin ft	17 0	1869	16 0 0	1886	26 0 0
400	326	0	0	1870	300 lin ft	12 6	1870	8 0 0	1904	29 5 0
250	563	10	0	1870	63 cub ft	25 0	1870	15 10 0	1895	43 0 0
960	748	0	0	1870	320 lin ft	12 6	1870	10 7 0	1903	23 0 0
330	128	5	0	1870	247 lin ft	27 0	1870	9 0 0	1897	56 11 0
360	308	0	0	1870	270 lin ft	11 0	1870	11 0 0	1897	28 7 0
390	62	5	0	1870	292 lin ft	12 0	1870	10 0 0	1907	32 10 2
1730	2210	0	0	1870	656½ lin ft	10 0	1870	8 0 0	1920	30 0 0
115	123	0	0	1870			1870	3 18 8	1870	3 18 8
600	326	5	0	1870	500 lin ft	20 0	1870	9 0 0	1938	35 0 0
330	2374	8	1	1870	165 lin ft	7 6	1870	7 2 6	1907	18 0 0
680	82	3	4	1870	85 lin ft	7 1	1870	11 6 8	1888	17 10 2
300	167	11	10	1870	50 cub ft	25 0	1870	22 6 11	1899	43 5 0
680	32	0	0	1870	850 lin ft	17 8	1870	12 0 0	1921	40 0 0
360	56	16	8	1870	28 cub ft	23 4	1870	20 13 4	1899	40 0 0
880	22	10	0	1870	700 lin ft	28 4	1870	9 0 0	1916	35 0 0
1200	65	0	0	1870	600 lin ft	25 0	1870	12 0 0	1917	50 0 0
640	33	0	0	1870	180 lin ft	7 6	1870	11 10 0	1906	21 12 0
700	224	0	0	1870	700 lin ft	20 0	1870	19 10 0	1906	40 0 0
42	260	10	0	1870		15 0	1870	24 0 0	1870	24 0 0
83	123	6	0	1870	..	27 8	1870	37 1 3	1870	37 1 3
320	92	0	0	1869	20 cub ft	10 0	1869	16 0 0	1896	30 0 0
46	322	14	0	1867	..	30 0	1867	49 0 0	1867	49 0 0
127	123	14	6	1868	.	25 0	1868	40 0 0	1868	40 0 0

TABLE No. II.—SALES BOOK.

Date.	Purchasers' Names and Addresses	No of Plantation.	Name of Plantation as per Estate Plan.	Description of Wood.	No of Trees.	No. of Feet.	Rate.	Amount.	Total.
1870.							s. d.	s. s. d.	s. s. d.
May 30	F. B., Banff.	1	A	Scotch pine	3850	...	0 6½	...	208 5 7½
June 3	A. T. G., Portessie	3	C	Larch	3902	...	0 9½	158 10 0	173 10 4½
" 7	A. T. G., Portessie	5	E	Spruce	800	...	0 4½	15 0 0	
" 10	J. T., Macduff.	22	U	Oak	...	400	2 6	...	45 0 0
" "	W. M., Keith	22	U	Elm	...	250	2 3	...	31 0 0
" "	J. M., Cullen	23	W	Ash	...	300	2 0	...	30 0 0
" "	T. R., Forchabers	23	W	S Chestnut	...	200	1 8	...	16 13 4

TABLE No. III.—THINNINGS.

Age of Plantation	No of Plantation.	Name of Plantation as per Estate Plan	Thinned in Year.		Value of Thinnings.		Cost of Work.
	No.	Name.	Year	Trees.	s. s. d.	s. s. d.	
	1	A	1869	3850	108 5 7½	23 5 1	
	2	B	do.	...	...	...
	3	C	do.	3902	158 10 4½	20 19 0	
	4	D	do.	...	...	...
	5	E	do.	800	15 0 0	2 0 0	
	6	F	...	...	...	...
	7	G	...	...	...	...
	8	H	...	...	...	...
	9	I	...	...	...	...
	10	J	1869	3000	...	3 0 0	
	11	K	do.	500	6 5 0	1 10 0	
	12	L	do.	600	7 10 0	6 0 0	
	13	M	do.	300	10 10 0	8 0 0	
	14	N	do.	500	...	0 12 0	
	15	O	do.	25	2 10 0	0 5 0	
	16	P	...	...	...	...
	17	Q	...	...	...	...
	18	R	...	...	...	...
	19	S	1869	200	2 10 0	0 10 0	
	20	T	do.	438	177 12 0	2 5 0	
	21	U	...	...	...	...
	22	V	...	...	...	...
	23	W	...	...	...	...
	24	X	...	...	...	...

TABLE NO. IV.—FENCING.

		Condition and Description of Fence at Date of Report.		Cost of Maintain- ing for Year to Date.	
	Year	Wire, Stone, Turf, &c	Year	£	s d
	1869	3434 { Turf, with three wires on top, re- quires repairing .	1870	100	2 0
	1870	2079 { Turf, with whins on top, needs repairs .	..	..
	1868	2719 Turf dyke, dilapidated .	1868	67	14 6
	1870	3021 Turf, with whins on top, good .			
	1868	1122 Turf, part railed and part wire on top .	1868	20	5 0
	1868	1638 Turf, with three wires on top .	1868	41	0 0
G .	1870	734 Turf, with three wires on top .	1870	18	7 0
H .	1868	7563 Turf, requires wire on top .		8	0 0
	1870	Included in No. 8			
	1870	Whin hedge, part included in No. 8			
K .	1868	5930 Turf, partly wired, part not .		8	10
L .	1870	1084 Turf, with three wires on top .	1870	18	10
13 M .	1870	1362 { Part turf and wire, part all wire fence .	1870		
14	1870	735 Post and rail, dilapidated .	..		
15	1870	442 Turf, wire on top, part all wire fence	1870		
16	1870	879 Turf, with three wires on top .	1869	5	0
	1870	1313 Turf, wire and rail on top .	1869	27	7
	1870	638 Turf, dilapidated .			
19	1870	1150 Turf, requires wire on top .			
	1870	1407 Turf and paling quite useless .			
	1870	728 { Part hedge and part stone dyke, useless .			
V .	1868	1768 Part 6-wire fence, part yet to fence	35	0 0	
W .	1867	{ Sunk dyke on one side, no fence on the other			
24	1868	Turf and whins, useless fence .			

TABLE NO. V.—DRAINING.

No of Families.	Name of Families as per Estate Plan.	Date of Report.	Extent of Drains.	Condition and Description of Drains at Date of Report	Date.	Description of Work, and how Per- formed.	Cost of Maintain- ing for Year to Date.
No	Name	Year	Yards	Description	Year		£ s. d.
1	A . .	1869	7860	{ Small open drains, requiring cleaning	..	.. ..	..
2	B . .	1870	3500	{ Small; requires cleaning	..	.. ..	..
3	C . .	1868	7860	Much grown up	1869 {	Deepening and clean- ing	11 14 0
4	D . .	1868	5000	Much grown up	..	Cleaning	..
5	E . .	1869	800	{ Some deep, and some shallow	1870 {	Cleaning and deep- ening	1 4 0
6	F . .	1868	6000	{ Shallow, and much grown up	1869	.. ..	9 0 0
7	G . .	1869	500	Small and shallow	..	.. ..	0 15 0
8	H . .	1869	.	Deep and good	..	.. ..	..
9	I . .	1869	500	{ Draining much re- quired	..	.. ..	..
10	J . .	1870	1000	Much grown up	..	.. ..	..
11	K . .	1870	1000	Much grown up	..	.. ..	..
12	L . .	1868	..	No drains required	..	.. ..	..
13	M . .	1870	500	{ Much requires clean- ing	..	.. ..	0 15 0
14	N . .	1869	300	{ Silted up; cleaning required	..	.. ..	0 9 0
15	O . .	1868	200	Much grown up	..	.. ..	0 6 0
16	P . .	1869	350	{ Draining and scour- ing required	..	.. ..	0 7 6
17	Q . .	1868	200	Much grown up	..	.. ..	0 6 0
18	R . .	1869	360	Some much filled up	..	.. ..	..
19	S . .	1868	500	Most of them clear	..	.. ..	..
20	T . .	1870	800	Quite grown up	..	.. ..	..
21	U . .	1868	600	Quite grown up	..	.. ..	..
22	V . .	1868	100	Quite grown up	..	.. ..	0 4 0
23	W . .	1870	...	No drains in it.	..	.. ..	..
24	X . .	1870	1000	Quite grown up	..	.. ..	..

TABLE NO. VI.—ROADS.

No. of Plantation.	Name of Plantation as per Estate Plan.	Year Report.	Extent of Roads in Acres.	Condition and Description of Roads at Date of Report.	Date.	Description of Work, and how Performed.	Cost of Maintaining for Year to Date.
No.	Name.	Year.	Yards.		Year.		\$ ¢ ¢
1	A . .	1869	1290	Broken and rough	1870	{ Levelling surface, &c. }	5 0 0
2	B . .	1870	..	{ Openings but no roads formed }	..	..	..
3	C . .	1868	1980	{ Rough and bad, culverts also bad }	1869	{ Roads and culverts repaired. }	7 10 0
4	D . .	1870	900	{ Grass roads, drains on sides }	..	..	.
5	E . .	1868	400	Grass road, good.	..	..	..

TABLE NO. VII.—MISCELLANEOUS WORK.

No. of Plantation,	Name of Plantation as per Estate Plan.	Date.	
No.	Name.	Year	
1	A . . .	1869	Killing squirrels.
2	B . . .	1869	Cutting whins.
3	C . . .	...	...
4	D . . .	..	...
5	E . . .	1868	Clearing snow from fences.

Before concluding this chapter, it may be well further to explain that the roots of the trees should not be placed under conditions where they are forced to absorb more moisture than the leaves can throw off or evaporate; therefore, when the moisture is great, the trees should have more room, and a greater amount of foliage.

The crop of larch, when six feet high (for timber), should not exceed 1200 per acre. If destruction by

game, &c., has necessitated closer planting, an early thinning, say at three or four years, should be adopted, and the crop reduced to the above number.

Thinning for timber should not be continued after the trees are about thirty years old, and the crop, according to description, cut down at fifty, sixty, seventy, or eighty years.

The crop to stand as timber at thirty years of age should not exceed 300 trees per acre upon good deep soil, and between 250 and 200 upon poorer soil. It is not essential, as has already been shown, in order to secure a proper crop, that the trees be either perfectly regular as to distance or of equal size, but in thinning this should be aimed at as desirable. A tree approaching maturity, having stood till its trunk is well-nigh cleared of branches to the proper height, may, in its present condition, stand a longer or shorter time, according as it is healthy and making wood or otherwise.

The layers or zones of wood should be about $\frac{1}{4}$ th of an inch thick till forty years old, $\frac{1}{8}$ th till fifty, $\frac{1}{10}$ th till sixty, and $\frac{1}{12}$ th till seventy or eighty years.

The form of a larch tree, grown for large timber, should be conical till nearly forty years old, and its girth in inches, a little above ground, should correspond to its feet in height. Say at forty years old it girths fifty inches, at same time it should stand fifty feet in height; at sixty years old, its girth at ten feet from the ground in inches should be equal to its height in feet; and at twenty feet from the ground, wh^{ere} it seventy

years old, its girth in inches should correspond with its height in feet.

In thinning, the aim should generally be to have upon the ground 1200 trees at ten years old, 900 at fifteen, 600 at twenty, 450 at twenty-five, and 300 at thirty years, to stand as a crop.

Larch, in the form of thinnings, and below thirty years old, should be peeled for the sake of the bark: the operation usually pays from 15 to 25 per cent., minus the cutting down and pruning. .

To grow larch well, it should be by itself or among hardwoods, but not mixed with evergreens, except to thin out early, and only under such circumstances as warrant the practice, from a demand for young larch thinnings in the district.

CHAPTER X.

PRUNING.

A FARMER in Strathspey planted some larch trees around his garden when he was a boy. The trees in time grew up, and the branches overhung his garden, suggesting pruning, which he did. Two of the number, not overhanging so much as the rest, were left unpruned; and at the present time, when the trees are seventy-one years old, the unpruned trees are more healthy, and contain more than double the quantity of timber than the others. If the branches of single-grown healthy larch are foreshortened moderately, it will do little or no harm, but evidently no good can arise from pruning in any form to unhealthy or diseased trees, unless perhaps in cases where blasting winds have destroyed the vitality of the ends of the branches: in such cases snag pruning will induce fresh shoots, or at all events remove the unsightly dead parts of the branches.

Some foresters attribute much of the larch failure to confinement of the trees, keeping them so close together as to destroy the vitality of their lower branches. To this view there appears scarcely room for division

of opinion ; the rule seems to be, to keep the latter in life till the heart-wood is fully formed with which the branches are connected. The shedding of the branches should never supersede the forming of the heart-wood and cortication of the bark. The importance of branches and their uses in developing a tree are too well known to require any comment.

One circumstance of considerable weight ought not to be overlooked, namely, that larch in its native country receives no such aid as the pruning-knife. If pruning, therefore, were essential to health and development, such trees as those at Dunkeld, Monymusk, Kippenross, Monzie Castle, Minto House, &c., would undoubtedly have come far short of the perfection they have attained.

As soon as the lower branches lose their vitality, they should be taken off with the pruning-saw, and the ground cleared of them for the mutual benefit of the trees and pasture. Dead branches cannot benefit a tree in any way, unless it be by indirectly maintaining moisture about the stem, and encouraging it to clear itself of them, for the benefit of the timber.

The larch, like the silver fir, is strongly disposed to produce double tops, and these should be looked to and pruned off wherever they appear. Many a larch tree is rendered almost valueless for want of being seasonably relieved of contending leaders. Every plantation between five and ten years old should be carefully gone over, and all double and contending shoots removed. They should also be gone over from time

to time afterwards with the pruning chisel as long as within reach, and all contending leaders cut clean off close to the main stem.

Of all coniferæ the larch stands pruning best, and it, above all other species of pine or fir, requires it most, except the silver fir.

On carefully inspecting some young larch plantations, I find from 30 to 40 per cent. are growing with more than one stem. Indeed plants that have been eaten over by game, or met with accidents from whatever cause, so as to lose their leader, invariably produce plurality of stems or contending leaders, and consequently require the pruning-knife more or less.

The branches, however, should not be interfered with nor pruned off till the bark of the tree has assumed its scaly and corky appearance, after which they may be safely checked by confinement, and pruned off when no longer vital.

CHAPTER XI.

MECHANICAL PECULIARITIES—TWISTING PREVENTED.

It is very wonderful how nature so amply provides for all her requirements, and in nothing is this more obvious than in the whole structure and economy of the larch. Let us look closely into some of those provisions. There is, in the first place, its thorough adaptation to withstand storm, tempest, and hurricane. Its natural habitat is that of the peak, ridge, undulating surfaces, serried and chasmed slopes. On its native Alps it enjoys all these, and along with them free exposure to sun, air, and clear atmosphere. Mr. Gregor, in his excellent book on arboriculture, says at page 217 : “ Although frequently fine specimens of the tree are to be met with on flats of sandy loam, on clayey gravel, and on various other qualities of soil, yet it is on the declivities, along the slopes of ravines, on the shattered *debris* and the disturbed soil of the land-slip and avalanche, that the tree is found to luxuriate in its greatest vigour. On the Alps and Apennines it luxuriates at a great height, and some scattered specimens of it are to be met with near to the highest range

of vegetation. In many of the Highland districts of Scotland, it may be observed filling the straths with massive timber, and ascending the mountain sides associated with the native pine; and with the exception of that tree, perhaps no other plant, native or foreign, was ever spread over so great a space in so short a period." When the whole structure of the tree is studied, it will be seen how thoroughly it is adapted to the soil, situations, climate, and other conditions under which it is destined to grow to perfection. The roots take a wonderful hold and establish themselves; amongst the barest of rocks, they succeed in anchoring gigantic trees. The barer the soil, the better, one would think, do the roots establish their hold. The limbs ever and anon extend in bold defiance against the wind and tempest, and, like the bold warrior, show unmistakable signs of sanguine combat. The tree in some exposures seldom makes headway more than a few seasons in succession, when some adverse blast or hurricane stops its vertical growth and sets it off at a tangent, in which new direction it proceeds till it constitutes one of those unique but picturesque projectiles seen in faithfully executed pictures of an Alpine landscape. The arm is not, however, allowed to proceed and extend at pleasure and unmolested, for the wind assails it with unmitigated violence, and though it seldom succeeds in dismembering the limb altogether, yet so far shatters and breaks it, as to make it pendulate in humble submission; and if the wind proves unequal to the

task of breaking the proudly extending arm, the snow-storm never fails to accomplish the ruthless work of destruction, in which it annually deals.

The branches of the larch, it will be observed, are splendidly constructed to bear a great weight of snow without breaking; they are formed in three regular bends or curves. That at the junction with the stem is downward, the next bend is upwards, and again the most remote is downwards. The peculiar manner in which the branch at its junction with the stem is bracketed or buttressed, is also as great a marvel as anything in nature. Let any one look closely into and see the swell of woody matter which surrounds the basement of the branch, like a skilfully constructed ferrule, and he will exclaim, "How wonderful!" Another remarkable provision of nature is the shedding of the leaves. If the larch, like all the other coniferæ, retained its foliage in winter, it could not possibly endure the hardships to which it is exposed. Even in its defoliated state the snow lodges upon it, and shatters its branches seriously at times; but if the far-stretching branches were at the same time covered with foliage, in addition to their copious spray, the snow would so completely lodge upon them, as utterly to denude the tree of every branch.

The principal objection to larch wood as a commercial and economic product is its tendency to warp and twist after being sawn or manufactured. There is found to be a great difference in the wood of one tree compared with that of another, and it has not been

generally ascertained why, or what the real cause of twisting is.

It is not a satisfactory answer to the inquiry, why does the larch wood twist, to say, because it is its nature to do so. That is true; but why it is its nature to do so, and not the nature of the spruce or Scotch pine, requires to be better explained. Trees that are grown perfectly upright with an equal proportion of branches on all sides, and, therefore, the layers equally thick all round the pith, and the pith exactly in the centre of the tree, do not, on being cut up, naturally twist. The soil in which the tree grows has much to do with the hardness of the wood, and, therefore, also with twisting. All larch wood does not equally twist. I have seen furniture of various kinds, agricultural implements, flooring, and roofing, &c., made of it, and nothing to complain of in regard to twisting. Again, in sawing the wood much skill is required, and it is by observing in which direction the natural curve or bend lies that successful sawing can be done. The trees, too, should be quite mature before being cut—that is, the heart-wood should extend to as near the surface of the trunk as possible. One principal cause of twisting is the presence of both sapwood and heart-wood in the same deal or scantling. If a deal be partly sapwood and partly heart-wood, the tendency is to curve to the sapwood side, because the sapwood contracts more, when exposed to sun and air, than the heart-wood does; therefore the stronger part forces itself upon the weaker, which gives way.

Peeling the standing trees and letting them stand one season before cutting has been tried to prevent twisting. This, however, is a dangerous and expensive operation, and does not answer the end in view, which may be otherwise better and more cheaply attained.

Larch timber should be cut in winter, and lie in the log with the bark on for about six or eight months; after that, if intended for flooring, doors, or such like purposes, it should be cut into large scantlings, or the trees simply squared with saw or axe, when it should be stacked up, or arranged for thorough drying or seasoning. Flooring cut out of the seasoned log, quickly dressed and laid, before receiving wet or excessive heat, will give no trouble or inconvenience in the workmanship, and, when once laid as a floor, no further trouble is experienced with it.

Many of the complaints are simply the notions of workmen, who prefer softer wood to work, and who, being thus prejudiced against it, conjure up all manner of complaints, either real or imaginary. "The chief objections to the timber of the larch," says Rhind, "are its liability to warp and twist; but this is said to be obviated by barking the trees in spring while growing, and not cutting them down till the following autumn, or even for a year afterwards; it is also said to prevent the timber from being attacked by dry rot." This, it is scarcely necessary to say, is a mistake, for it has been satisfactorily proved, almost beyond dispute, that it has no influence either in preventing dry rot or twisting, beyond what can be accomplished

by laying the wood up in logs to season, and, when perfectly dry, sawing it up.

Peeling rather injures than improves the quality of the timber, especially the sapwood. Of two posts put into the ground of the same class and quality of wood, the one peeled and the other with the bark on, especially if cut in winter, the sapwood of the latter will be strong at twelve years, while that of the former will be a pulpy mass at eight years: the results, however, between peeled and unpeeled wood differ very greatly under different conditions.

CHAPTER XII.

TIME OF MATURITY.

WHEN the agriculturist sows or plants a crop of any kind, he calculates how long it will take to come to maturity, makes his calculations, and lays his plans accordingly. In like manner should the forester know how long in planting any piece of ground it will require to bring the crop to maturity, or to its highest state of perfection.

Two kinds of soil will bring larch to maturity in thirty years. They are of two wide and different descriptions, and yet produce results the same in one respect, though different in others.

An open, porous, moist, white sandy loam, abounding in about equal proportions of white sand and clay, will bring a crop of larch to maturity within the above period.

On Buckhurst Park Estate, in Sussex, a larch plantation was cut down in 1854, the trees of which averaged about thirty cubic feet of timber, and though the wood was soft when cut, yet, on being seasoned, it acquired greater hardness, and as weather-boarding it has stood up to this time (now twenty-six years), and

is still in good preservation. The plantation altogether comprised about six acres, and comprehended, on an average, sixty trees per acre, containing thirty cubic feet each = 1800 feet at 10d. per foot = £75 sterling.

Another, a larch plantation on Cullen Estate, of thirty years' growth, comprises about twenty acres. The ground was originally thin moorland, covered with heather, but had been under cultivation for some years previous to planting. The part thus cultivated was planted with larch, and grew up in fair condition. At thirty years old it was found that the trees in many cases had begun to decay in the heart, and that they were in the best paying condition to cut down at the above age. The trees were not large, being grown on the top of a hill about 700 feet altitude, and soil light, and were rather close together at an early and important stage of growth, which considerably interfered with their development.

On making a valuation of the crop the other day, it stood thus: 200 trees per acre at three cubic feet each = 600 feet at 1s. per foot, £30. This to many may appear a small value per acre, but it has to be borne in mind that the surrounding ground was not worth more than 10s. per acre, and the ground for pasturage, previous to planting, worth only about 2s. 6d. per acre, which is now worth fully 5s. per acre for that purpose. Various soils produce various results, and the time at which a tree may be said to be at maturity is just when it has attained its greatest perfection. The age at which many authors state the larch as being

ripe and mature varies so greatly that little reliable information can be gleaned from them. Mr. Rait, in his table of weights of wood, quotes the larch at sixty years, but does not say it is ripe at that age. Mr. Gregor gives the following interesting statement regarding the growth of the larch:—At Ballindalloch Castle, on the banks of the Spey, there lately stood some large specimens of the tree, which were planted in 1767. The following table shows the girth of these trees at the age of seventy, and their progress up to 1851, after having been planted eighty-three years:—

GIRTHS IN AUGUST 1837.					GIRTHS IN JANUARY 1851.			
	At 1 foot.	At 6 feet.	At 12 feet.	At 18 feet.	At 1 foot.	At 6 feet.	At 12 feet.	At 18 feet.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
No. 1. .	9 6½	8 5	8 4½	6 6½	11 8	9 6½	9 3	7 7
No. 2. .	8 7½	7 1	6 4	6 0	9 10	9 0	7 5	7 1
No. 3. .	10 6	8 4	7 1	6 6½	13 5	9 8	8 2	7 8
No. 4. .	9 1	7 3	6 5	6 4½	10 6½	8 4	7 7	7 5

At Monymusk, in Aberdeenshire, there are some splendid specimens of the larch, twelve of which indicate a great growth after having attained over a hundred years of age.

Mr. Smith, in his marvellous little book, states that an acre of larch at less than forty years' growth is ready to cut, and worth £125. This, it need scarcely be said, is a purely theoretical calculation, both as respects age and money value.

The Duke of Athole gives the age at which larch should be cut at seventy-two years, and says at that age the trees should contain sixty cubic feet.

Mr. Charles M'Intosh, in his treatise on larch disease, says: "The trees at Dunkeld, Monzie, Craigdarroch, Kirkconnel, &c., will, in all probability, if no accident overtake them, arrive at something like their natural period of existence; indeed, they are already approaching the period assigned them by Wildenow, who states the natural duration or life-existence of the larch at from one hundred and fifty to two hundred years. This, however, shows us that the larch, even in its natural habitats, is, compared with many other species, by no means a long-lived tree."

No wonder that such varied dates are given as those at which larch should be cut as mature, seeing it is influenced by so many and varied circumstances. The fact really is, that no time can be specified for its maturity, as some trees may, under favourable, or rather unfavourable circumstances, have attained their highest value and perfection at or below thirty years' growth, while others may be still growing profitably at sixty years, others again at one hundred years, and others again at one hundred and fifty years, or even more. Soil, situation, climate, and other influences all go to determine the time when trees should be cut as mature, or most profitable.

An opinion has been advanced that the larch, not being a tree indigenous to Britain, is degenerating in consequence of change of climate; but this is deemed a very untenable argument by those who adduce the cases of the sycamore and the horse and Spanish chestnuts as suitable, some of which have flourished in this

country for more than seven centuries. It should, however, be borne in mind, that the very aged specimens of those trees are all found growing in situations the best adapted to ensure longevity, both as regards soil and shelter, having all been planted near monastic or baronial residences, and that no such specimens are to be met with where the soil is not congenial to them. Besides, there is a great constitutional difference between hardwood trees and that of the order *Coniferae*. The former have the power of renewing such portions of their structure as may become injured by accident—nay, even of renewing themselves entirely from the root, should the whole body perish—while coniferous trees (young larch excepted) have no such power or inherent vitality.

I have often seen young larch trees spring from the root and produce excellent trees after being eaten to the very surface of the ground by rabbits, and sometimes even when the upper part is killed by blister the lower part produces shoots, and the tree starts afresh. The manner in which larch stools sometimes keep alive after the trees are cut is also very wonderful. One stool at Cullen House is quite fresh and making wood, although the tree was cut nearly thirty years ago. Mr. Webster, in the "Gardener's Chronicle" of June 24, 1871, p. 806, and August 31, 1872, p. 1161, not only gives a faithful and interesting account of stump or posthumous growth, or the manner in which tree-roots become inosculated with each other, but also

true figures of specimens discovered by him in the grounds at Gordon Castle, and exhibited at the Congress at Birmingham, and which elicited much commendation.

The larch, unlike the Scotch fir and most other forest trees, is in an important sense mature at almost any age, or at least may be cut as profitable whenever it is large enough for the purpose required. The following are examples of the growth of the larch under favourable circumstances :—

Clunyhill plantation, the town property of Forres, Morayshire, surrounding the Hydropathic Establishment, was planted in 1846, and is thus thirty-five years of age. The average girth of twelve trees at 10 feet from the ground, measured over the bark, is 41 inches, and average cubic contents 14 feet. The trees have all ample room and are very healthy.

Mr. M'Lean, forester at Altyre, Morayshire, gives as the average girth of some groups of the larches in the Altyre Estate plantations at 10 feet from the ground, 35½ inches. The trees are forty years old, and contain 11 cubic feet including (or 9 feet exclusive of) bark, all healthy and of vigorous growth.

Groups in a larch plantation on Innescara Estate, County Cork, Ireland, forty years planted,—girths, on an average at 10 feet from the ground, 40 inches, and contain an average of 13 cubic feet including bark, or 11 feet excluding it.

: At Ardross Castle, in Ross-shire, the average of

some groups of larches thirty years planted, girths 37 inches at four feet from the ground, and contain an average of 12 cubic feet including bark.

A larch plantation at Finzean Castle, in Aberdeenshire, forty-eight years old, comprehends some larches containing 30 cubic feet of measurable timber.

At Glenelg, in Argyleshire, there are some very fine growing larch plantations, but the wood is more celebrated for its quality than size. A few trees taken at random, sixty-five years of age, girth 9 feet 11 inches at the ground, and at 10 feet above ground 6 feet 3 inches; also a very young plantation, eleven years old, contains some trees 22 feet in height, and 30 inches in girth including bark.

Mr. M'Kenzie, wood manager, Murthly Castle, Perthshire, gives the following statement of an extensive plantation on the estate, part aged forty-one, part forty-two, and part forty-four years. Of twenty trees measured, they girth respectively: four of them, $39\frac{1}{2}$ inches; three, $38\frac{3}{4}$ inches; two, $37\frac{1}{4}$ inches; two, 36 inches; five an average of $33\frac{1}{2}$ inches; and the remaining four, $34\frac{1}{4}$ inches. The average girth of the whole trees in the plantation is computed at 37 inches at 10 feet from the ground, including bark.

In another plantation on the above estate, forty-two to fifty-five years old, the trees stand 40 to 70 feet apart, and average 44 inches at 12 feet from the ground.

Some of the largest and best trees girth 50 inches at 12 feet from the ground, and measure 7 inches diameter at 65 feet up.

At nine feet from the ground they are increasing at the rate of half-an-inch diameter annually, are generally in very good health, and few trees have at any time been uprooted with the wind ; a testimony in favour of the trees having ample room and being consequently well rooted.

CHAPTER XIII.

USES AND VALUE OF WOOD.

THOUGH larch was at one time considered of almost no value, either for rural or domestic purposes, it is now found to be one of the most useful and accommodating products of the forest. Indeed, I am not aware of any species of timber tree that can with advantage be turned to so many different purposes. It can be used for outdoor and indoor work alike in a manner that no other timber can. There is scarcely an agricultural implement, machine, or tool of any kind in which wood is used but larch can be employed. Furniture of all kinds, the choicest and the best, is made from it, and its applications are constantly on the increase. Ships of every tonnage, and destined for every clime, have been successfully built of larch. The first vessel constructed of larch in this country was a frigate of thirty-six guns, named the *Athole*, built at Woolwich, and launched in 1820. About the time the *Athole* frigate was building at Woolwich, the well-known firm of Messrs. Sime & Co., shipbuilders, Leith, purchased from His Grace the Duke of Athole one of the five original "mothers" grown at Dunkeld, containing

168 cubic feet of timber, at the extraordinary price of 3s. per foot, or £25, 5s. for the tree, at the same time purchasing also some other younger and smaller trees, with which they built the *Simon Taylor*, West Indianman, which was unfortunately lost on her first voyage. She was probably launched in 1820 or 1821, but the exact date I have not been able to ascertain.

Shortly after the above, a third vessel was built, a brig of 171 tons, by a firm in Perth, entirely of the Athole larch, and bore the name of the wood of which she was built—the *Larch*.

In some quarters a strong antipathy to larch for all naval purposes existed, and it was not till within the last fifty years that it was overcome. About 1820 a boatbuilder in Cullen, having seen or heard of the suitability of larch for certain parts of a boat, ventured, in order to introduce the wood, to put in one timber into a boat he was building, and it having been discovered by or pointed out to the fisherman for whom it was being built, he gave peremptory orders for its extraction, adding, "Put in willow, alder, or spruce fir, or indeed anything but that dangerous, dismal larick."

About the year 1845 a ship was built at Dingwall of larch grown on the Fowlis estate in Ross-shire, first named the *Fowlis*, and subsequently the *Indestructible*. This vessel, after many years' coasting service, was at last accidentally destroyed in the following manner:—She was loaded with limeshell from a southern port, and on her way north encountered a severe gale, which

occasioned water to reach the lime, and the result was the rending to pieces of the hull and ultimate sinking of the vessel.

In addition to those mentioned above, hundreds if not thousands of ships and craft of all kinds have since been built of larch, and are the most durable of all ships, though not so highly classed in Lloyds' register as oak-built vessels.

I have seen ploughs, harrows, carts, wheelbarrows, swingletrees, rakes, ladders, stiles, and I believe almost every implement in use upon the farm in which wood is used, made of larch, and it answers well in all its requirements. Of domestic utensils may be seen in daily use washing-tubs, churns, barrels, pails, cogs, buckets, &c., all made of larch.

Furniture is now extensively made of larch, such as bedsteads, tables, chairs, forms, presses, and almost every article of household furniture.

For rural purposes it is now almost the only wood used for fencing, posts, gates, gate posts, palings, sluices, bridges, &c. For building purposes it is not so extensively used as it otherwise would be, because of its comparative scarcity and dearness; but if only cheap enough, there is no doubt it would be used for roofing, sarking, flooring, and almost every kind of woodwork, especially if the method of growing and seasoning were sufficiently well known to prevent twisting or warping, which have been treated of under Chapter XI.

For railway sleepers and mining purposes the larch

has no rival, and by a recent Act of Parliament it can now be used for herring barrels, a purpose for which it was formerly excluded, as it is found in practice that larch wood retains the brine equally as well as birch, sycamore, alder, and those kinds of hardwood hitherto usually employed for that purpose.

It is also used for sleepers for cellar floors, lintels, pillars for supporting sheds, and indeed for any part of a building, if it be at all well grown and thoroughly matured.

The skin or covering of herring and other boats, $\frac{4}{5}$ ths thick, is now almost invariably made of larch.

It is said that in Switzerland the houses are covered with boards one foot square, and the resin it emits fills the joints, cracks, and crevices. It is white when put on, but in a few years turns black and shining.

The larch is useful for some purpose or other at almost all stages of growth, every size of tree, and every part of it—the bark for tanning, the branches for wattle fencing, while the juices yield the turpentine of commerce. It also yields a gum known in Russia as the gum of Orenburg, containing properties similar to that of gum-arabic, and is used by the Russians as an article of food. The leaves of the larch and young shoots exude a substance called manna, which is sold in the shops of France as *Manne de Briançon*. It forms in small white concrete drops, and is gathered in the morning before it can be dissipated by the sun's rays, has a sweet taste, somewhat similar to that of new

honey, but has a turpentine flavour, as it contains some turpentine. The *Boletus Laricinus*, a globular-shaped fungus which yields a fine purple dye and has been somewhat extensively used in medicine, is found in the trunks of old trees in the northern parts of Europe.

If an edict were passed forbidding the growth of all but one species of tree in this country, there is no manner of doubt but that one would be the larch.

The root of the tree is as important and valuable as any other part of it, and is extensively used in boat and ship building as knees or crooks for supporting the decks. In throwing the trees, which is done by grubbing, from 2 to 3 feet of the stem is left attached to the root, and the block thus cut off is set on end and cleft with the saw, sometimes into two, sometimes into four or more pieces, according to size and suitability of the root. Such roots realise prices varying from 10s. to 50s., according to size, &c. The proper mode of larch cultivation favours the growth and development of such roots, and it may fairly be questioned if the tree has been grown under favourable conditions when it does not produce largely developed knee roots.

It is not to be thought that grubbing the trees is at all laborious or expensive work. In some cases, as on moss or peat soil, two men will as soon grub a tree as cut it down close and level with the surface of the ground. The grubbing should, however, in most cases be done by contract, and will cost from 1s. to 2s. 6d.

per tree, according to size of tree and description of ground, &c.

The commercial value of larch is very great: scarcely any product of the soil is more valuable, and certainly no species of timber is so much sought after and so highly esteemed. The price of larch timber has greatly fluctuated and decreased since the year 1809, when the Duke of Athole obtained from 3s. to 3s. 6d. per cubic foot of wood.

In Scotland, as in other countries, the prices are now much more equalised than in former years. The prices now obtainable for larch timber throughout Scotland (I might say Britain) vary from 10d. to 1s. 6d. per cubic foot. As a rule, larch is dearer and oak cheaper the farther north one goes, though to this rule there are exceptions in certain localities.

The greatest demand for larch at the present time is for railway sleepers, props for mining purposes, and fencing of all kinds, especially stakes for farm fences. The bark of larch under forty years old is valuable for tanning, and pays from 20 to 25 per cent. upon the labour, minus felling the trees.

It is sometimes asked, What proportional duration does the sapwood of larch bear to the heart-wood? The question is difficult to answer directly, but may be understood thus:—A larch tree twelve years old will stand as a paling-post three years, at the end of which time the heart-wood is quite decayed. At twenty years old the root-cut will stand as a post four years, and the heart-wood one year longer, or is one-fifth more durable

than the sapwood. At forty years old the sapwood of a larch post will stand five years, and the heart-wood would stand for ten years, hence the heart-wood is twice as durable as the sapwood. There is considerable difference in the quality of sapwood, but not nearly so much as in the quality of the heart-wood.

The returns from larch plantations are very variable; in some cases they have paid well, in others they have proved a great loss. The districts where larch have paid best are upon dry, porous land, precipitous rather than flat, but generally thin and poor. Some have concluded that the north country is better adapted for larch than the south. In this there is no great difference, save what soil and situation produce. There are equally as good larches in the counties of Sussex, Surrey, and Kent, as there are in Inverness-shire, Ross, or Sutherland; but in the latter counties good larches and larch plantations are more numerous and extensive.

In Wales there are many fine larches of all ages, not exceeding one hundred years, and disease is little known, save upon slate rock, and even there only on wet and cold clays. Throughout North Wales, wherever larch has been planted on dry soils and duly thinned, the crops have proved remunerative. The accounts from Ireland are also favourable, and disease is all but unknown; the exceptional cases are upon soft, boggy ground, where the roots decay, just as in Scotland upon certain mosses, cold clays, &c.

No proprietor in Scotland has suffered so much

from diseased larch as His Grace the Duke of Buccleugh, and the reason is that extensive tracts of damp clay land have been planted. In Liddesdale, and the southern parts of Teviotdale and Tweeddale, larch in general grows indifferently, owing doubtless to the cold and clayey soils that prevail. It is also owing to the cold clays in Roxburghshire, Selkirkshire, Peeblesshire, and Dumfriesshire that so much disease has occurred amongst the larch. In the above-named counties, where the soil is sufficiently dry to maintain life, the trees frequently survive to forty years old, and contain from 8 to 10 cubic feet of red, hard, and most durable wood, which, though not of large dimensions, pays well to grow for fencing purposes and common farm buildings, including cottage roofs.

It appears that the quality of larch timber does not depend so much upon the maturity of the tree and the slowness of its growth as that of the pine tribe. A fishing-boat built of larch only forty years' growth has been found to last three times as long as one built of the best Norway pine. It is not so buoyant, however, nor so elastic, and as it does not dry so completely as pine, boards of it are more apt to warp. It is, however, much more tough and compact; and, what are very valuable properties, it approaches nearly to being proof, not only against water, but against fire. If the external timber and the principal beams of houses were made of larch, fires would not only be less frequent, but they would be far less destructive; for before a larch beam be even completely charred on the surface, one of pine or of

dry oak will be in a blaze beyond the ordinary means of extinction. Larch, however, is heavier to transport and elevate, and also much harder to work, than pine; and as these circumstances are all against the profits of the builder, they probably often prevent the introduction of this most safe and durable timber. The Venetian houses constructed of it show no symptoms of decay; and the complete preservation of some of the finest paintings of the great masters of Italy is, in some respects, owing to the panels of larch on which they are executed.

According to Sang, the superiority of the larch over the Scotch pine is that it brings double the price at least per measurable foot; that it will arrive at a useful timber size in one-half or a third of the time which the pine in general requires; and above all, that the wood of the larch at forty or fifty years old, if in a suitable soil and climate, is in every respect superior to that of the pine at one hundred years old.

The bark of the larch is more than half as valuable as that of the oak in tanning, and the tree yields turpentine by incision. The best timber is that which has grown on elevated, cold, and bare soils.

The larch yields a large proportion of the Venice turpentine of commerce. A hole is bored with an auger into the heart of a stem of not less than a foot in diameter, and at a point about two feet from the ground, and a small pipe is fitted into the hole to convey the slowly flowing turpentine into vessels. Quantities of turpentine are obtained in this manner

in various parts of the Continent, and particularly in Provence, from May till September.

Mr. J. Stewart, Inveraray, says, the larch, whether as a denizen of the forest or a commercial or industrial product, may be considered as the most profitable of all the coniferous tribe. From its toughness and durability when old, sound, and well grown, there is almost no kind of work it cannot be used for.

The wood, says Mr. J. Fingland, is a great deal lighter for carting, and when well dried, better adapted for paint or coal-tar; but all large timber used in carpentry, furniture-making, and other important purposes should be cut in the winter season: the wood then cut is richer in colour, and receives a higher polish, than when cut in summer. The principal rooms in Drumlanrig Castle are furnished from home-grown wood all cut in winter. It is quite true, that the wood has a strong tendency to open and split if peeled and dried in the sun, but better lose the bark, valuable though it be, than spoil the valuable timber for the sake of the bark.

CHAPTER XIV.

DURABILITY.

THE durability of larch, although very great, is yet by some considerably exaggerated. Evelyn recites a story by Witsen, a Dutch writer, of a ship built of this timber and cypress, that had been found in the Numidian Sea, twelve fathoms under water, sound and entire, and reduced to such a hardness as to resist the sharpest tool, after it had been submerged above 1400 years. The larch is said to have been known to Julius Cæsar; and it is in consequence of some of the finest paintings of the great masters of Italy being done in larch that they have been preserved, which it is believed could not have been the case if done upon any other kind of wood.

It is, however, more with modern practical subjects than ancient history that we have to do, and to inquire how far the durability of larch, as now known, agrees with well-authenticated records, and specially as inducements to attend to its better culture.

The following examples have come under the writer's personal observation, and are only a few out of many that might be cited:—

No. 1 was a post-and-rail fence on the roadside leading from Keith to Cullen in Banffshire. It served as a roadside and plantation fence combined, and was erected in 1839. It was recently taken down, and the posts, which were six inches square, were in many cases perfectly fresh and sound, except a little decayed on the outer surface. The rails, which were 4 inches by 3, were in still better preservation than the posts. The trees from which this fence was procured were, when cut down, fifty-six years old, and grew on the highest part of a hill about 800 feet altitude, and distant from the sea about four miles. The larch was very red and hard, and the trees contained only about 7 cubic feet of timber. The fence, it will be observed, stood forty-one years, and to all appearance with some slight repairs might have been a useful and serviceable fence for at least ten or fifteen years longer.

There are at the present time some of the same class of trees from which the above paling was constructed still remaining in the plantation, which exhibit approximately some of the characteristics described by Evelyn and some other old authorities, which younger men are inclined to repudiate.

The wood is so hard as to resist almost any axe, is as red as mahogany, and almost absolutely refuses to burn in the fire. Had the wood of this fence been carefully selected, and only the best of it used, it is evident the fence would have stood, without almost any repairs, full fifty years.

No. 2 is a plantation wood-and-wire fence, taken

down and replaced by an iron standard one in 1870, after having stood eighteen years. The posts were put in round, with the bark on, and were the gleanings of a plantation forty years old.

The soil in which the posts stood was a stiff clay, and they were sharpened and driven into the ground with the mell or mallet in the usual way. On taking down the fence, it was found that though all the sapwood was completely decayed, so much so that it was easily removed with the unaided fingers, yet the heartwood was almost as good as ever, except at the surface of the ground.

The plantation from which the posts were taken grew at an altitude of about 800 feet, was freely exposed on all sides, with a red clay soil, moderately dry. The trees still remaining in the plantation are mostly decayed in the heart at the root.

No. 3 is a good and serviceable wood-and-wire fence, erected in 1859. The soil is a cold stiff clay, the situation freely exposed on all sides, and altitude about 600 feet. The posts were all either peeled or the bark shaven off. When fresh and full of sap they were peeled, and when dry they were shaven.

The plantation from which the posts were taken was only twenty-six years old, and situated on the top of a hill fully 500 feet altitude. They are mostly in fair preservation, but a few have been replaced.

This is an example of the durability of larch, and proves that trees, though comparatively young, if grown in a well-exposed place and at a high altitude,

will last long, even under the trying condition of a fence post.

No. 4 is a post-and-rail fence, composed of round posts and half round rails. It is situated on the county roadside, about midway between Hawick and Ashkirk, county of Selkirk. The fence was erected twenty-eight years ago, and may to all appearance stand ten or fifteen years longer. It has been occasionally painted, and the posts charred and frequently tarred at the surface of the ground. The situation is a cold and exposed one,—the soil in which the posts stand, a red sandy clay. The trees from which the fence was made were apparently not over forty years old, and of slow growth, probably grown on Sinton estate. The tarring, which was done with Archangel tar, might have a preservative influence, but I do not think the charring could in any way benefit them.

No. 5 is an example of how far certain soils induce posts to decay while others preserve them. A knowledge of the fact that wood remains sound for an indefinite length of time in peat, bog, and moss has led many persons astray and into serious errors. Take the following as an example:—A Banffshire farmer took a nineteen years' lease of a farm, which he undertook to fence and maintain in good repair at his own expense to the end of his lease, and as about one-third of the farm was reclaimed from peat-bog and thoroughly drained, he concluded that one set of posts, although of medium quality, would stand the lease; but instead of

that, to his dismay the posts had all to be renewed in about six years.

The draining had rendered the peat soil or flow moss the most destructive of any, and the more it is rendered dry, the worse it is. On renewing some of the fences, it was recommended to cart clay soil sufficient to pack a small quantity round each alternate post. This was done, and to all appearance will prove of very great advantage in preserving the posts from rot at the surface of the ground.

Posts put into light, dry, sandy or peaty soils will decay in less than *one-third* the time the same quality of wood will last in stiff clay or wet mossy soils. This, it must appear evident, renders the difficulty of testing the durability of wood all the greater.

No. 6. About 1838 a march fence was erected between two hill-farms in Roxburghshire belonging to His Grace the Duke of Buccleuch. The district where the fence was erected was on the Cheviot Hill range, about 600 to 1000 feet altitude. The line of fence was several miles in length, and therefore passed through various kinds of soil; some dry, others wet, some stiff, and others light. On examining the fence after having stood twenty years, it was found that the preservation or decay in a very great measure depended upon the soil in which the posts stood. In sandy loam they stood the shortest time, and in wet peaty soil the longest. The posts were all put in with the bark on, and received neither charring nor tarring at any time.

No. 7 is a wire-and-wood fence erected in 1856 to divide two fields on the home-farm at Cullen House, and, by way of testing the advantages of two ways of securing the posts, the following plan was adopted:— Each alternate post was secured by digging a pit and placing stones all round it, and beating them down firmly by means of a rammer or bishop; and the other half were driven into the ground by means of the fencing mell or mallet. On making a careful examination of the fence the other day, it was found that those posts secured with the stones were in best preservation, and are calculated to stand much longer than those in the common soil. Stones or strong clay are good to place around posts in sandy or light peaty soils, but in clay or wet moss there is no need of stones to preserve them, the soil itself being equally effective in preserving them.

No. 8 is an example of the durability of larch in the form of rustic plantation gates. The gates, to the date to which this account applies, had hung about twenty years, and had not received any repairs. At the mortises they were somewhat decayed, but most of the wood had acquired a remarkable hardness, almost like bone. The gates were upon an old plantation, and seldom opened. The wood from which they were made grew on the top of a hill 500 feet altitude, and when cut the trees were about fifty years old. They were the smallest class of trees in the plantation, and might be regarded as the weeds or gleanings.

No. 9. On the farm of Teinside, in Teviotdale,

several gates were hung upon larch posts, taken from plantations in the neighbourhood. They were erected in 1851, and are at this date (1880) still in fair condition. The soil in the district is clayey, and inclined to wetness, altitude about 400 feet, and climate damp and cold.

No. 10. On a farm about five miles from Hawick some gate posts were put in, which, at the end of twenty-six years, were still serviceable and good. They were taken out of adjoining plantations, of about sixty years' growth, where the soil is cold and clayey, altitude 400 to 500 feet, and soil into which the posts were put also wet and clayey.

The purposes for which larch timber seems preferable to every other kind are chiefly these: gates, palings, posts of all kinds that are inserted either in the earth or in water, wooden buildings, agricultural implements, cottage furniture, bridges and gangways, carriages for transporting stones and all hard and rough materials, barrows for builders and roadmakers, embanking piles, lock and dock gates for canals and harbours, coal and lime waggons, vessels for carrying lime, pit props, and top-poles of the smaller thinnings. For all these purposes, and many minor ones, larch would come considerably cheaper than any timber now in use, and would, in the average of them, last at least thrice as long: the saving to the public would thus be immense; and the lands upon which an abundant supply might be raised in every county are at present lying waste.

On the farm of Ardoch, about three miles from

Cullen, a post-and-rail fence was erected, with the view of testing the advantage of putting the posts into the ground in the inverted position. [In Ireland, I am informed, the posts are always, or at least in certain districts, put in with the top end downwards, and that they last much longer than when put in root end down.] The fence referred to had stood about twenty years, when it was taken down and replaced with a wire fence. * Without stating the object, I gave instructions to the foreman to lay carefully aside all the posts sufficiently good to repair other fences with, and on inspecting the posts one by one, there were considerably more of those which were put in top down than the others. This, however, is not conclusive proof that it makes any important difference which end goes into the ground, but it is hereby suggested that those who have the opportunity should further carry out the experiment.

The drying sheds of Tochnéal Tileworks, Banffshire, are all of wood, and the pillars which stand in the ground are all larch. The sheds have stood over forty years, and the pillars to-day are almost as sound and good in many cases as when put in. The only decay is a little at the surface of the ground. The soil is damp cold clay on all sides.

CHAPTER XV.

WEIGHT OF WOOD AND BRANCHES.

It is the size, quality, and usefulness of the timber that are generally looked at from a commercial standpoint, but there are other views to be taken of the subject, some of a truly practical, and others of a theoretical, but no less interesting nature. Those deeply and warmly interested in the culture of trees like to know everything about them, small and great, and if there are any real or supposed mysteries or secrets. Such invariably form the subjects of greatest solicitude.

On looking at a goodly plantation, of say fifty years' growth, one is prompted to inquire, not only how many cubic feet of wood there are per acre, but what the weight of the whole wood is, including or excluding branches. If the plantation be a young and growing one, it is important to know how much is added to the weight of the crop every year it stands, and if the whole produce is to be carted off to a distance of say ten miles to a railway station, what it will cost to do so, or how much is to be deducted from the value of the standing crop as allowance for cartage. .

I selected six trees of fair proportions, carefully measured and weighed them, in the winter season, green, and the following are the results:—

No	Soil Grown on	Age of Tree	Entire Length of Tree	Girth at Base	Girth at Middle	Weight of Stem	Weight of Branches	Weight of Annual Growth of Stem and Branches	Total weight of Stem and Branches
		years	ft in	in	in	lbs oz	lbs oz	lbs oz	lbs
1	Moderate soil	19	27	20	10	91 0	25 0	6 $\frac{1}{2}$ 0	116
2	Poor "	10	13 $\frac{1}{2}$ 0	14	6	23 0	18 0	4 $\frac{1}{2}$ 0	41
3	Good "	10	16 0	13 $\frac{1}{2}$	6	29 0	20 $\frac{1}{2}$ 0	5 0	49 $\frac{1}{2}$
4	Medium "	7	4 $\frac{1}{2}$ 0	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$ 0	1 $\frac{1}{2}$ 0	0 6 $\frac{1}{2}$	2 $\frac{1}{2}$
5	Good "	5	4 6 $\frac{1}{2}$	4		0 15 $\frac{1}{2}$	1 10 $\frac{1}{2}$	0 8 $\frac{1}{2}$	2 $\frac{1}{2}$
6	" "	7	6 2	5 $\frac{1}{2}$		2 1	3 12	0 13 $\frac{1}{2}$	5 $\frac{1}{2}$

NOTE.—Numbers 5 and 6 were cut and weighed when the trees were in foliage, while the others were cut in winter

A cubic foot of mature larch timber, including bark, is about 70 lbs. weight, and about 36 cubic feet make a ton weight. The weight and measurement of wood seldom agree, for the simple reason that the various methods of measuring give different results. Mr. Rait, Castle Forbes, Aberdeenshire, has supplied an important want in this respect by his carefully prepared published tables, which are worthy of consultation by those interested in the subject. The following is a specimen of tables referred to:—

CHAPTER XVI.

BARK.

THE bark is the external coating or covering of the stem, branches, roots, and every part of the tree. It consists of three distinct parts or coats. The inner part, next to the sapwood (*alburnum*), is called the *liber*, or inner bark, and is the part containing the tannin property used in the manufacture of leather. The next, or central bark, is called the *parenchyma*, or *cork-bark*, which, in the stem, branches, twigs, and all parts above ground, is first of a juicy, green colour, very delicate, tender, and sensitive, probably the most tender of any part of the whole structure of the tree. The outer bark of all is called the *epidermis* or *cuticle*, and forms a sort of enamel to the whole structure of the young wood. The liber, or inner bark, is increased annually in a manner similar to that of endogenous plants by additional annual layers being added to its inner surface. The liber is fed from the inside, and can sometimes be seen and counted very distinctly, the same as the layers of the woody structure of the stem, root, and branches; and in the case of the larch and pine tribe generally it is most observable and distinct. The

incessant and powerful strain, however, caused by the additional annual layers of wood from within the bark, and the rupturing of the longitudinal vessels of the liber, often so completely obliterate the divisions of the layers that they are very indistinct, and sometimes impossible to count from that cause, otherwise the age of the tree could be as accurately ascertained from the layers of the bark as from the layers of the wood. The parenchyma of the young shoot is converted into liber in the first place, and then the liber excretes what in turn becomes the parenchyma proper. The membrane between the alburnum or sapwood and the epidermis or outer covering of the bark has a very wonderful part to perform in the economy of the tree's growth. From the alburnum the substance termed the liber is secreted. The parenchyma is secreted from the liber, and again the epidermis from the parenchyma. There is, therefore, as respects the whole progress of the growth of the bark, an endogenous process carried on from first to last, from the forming of the primary section or shoot to the maturation of the monarch centuries old.

It may be said of the larch tree as of clean fish—every part is useful, and none should be thrown away, neither flesh, bones, fins, nor skin. The bark of the larch is of very considerable commercial value, and, after paying expenses of peeling and harvesting, &c., leaves a favourable balance in its favour, generally about half that of the oak.

Amongst other examples that have come under my

observation are the following:—A larch tree containing 36 cubic feet of timber yields 16 stones of green bark, equal to 9 st. 7 lbs. dry. One square foot of bark, taken from the tree one foot above the ground weighed 1 lb. 14 oz. green, and 1 lb. 4 oz. dry. One square foot from the middle of the tree weighed 1 lb. 3 oz. green, and 12 oz. dry. One square foot from near the top of the tree weighed 1 lb. 2 oz. green, and 15 oz. dry.

In stripping larch bark none is taken from the branches of the trees, but only from the stem; and in stripping it the mell or mallet is seldom found necessary, as when cut into lengths upon the tree it comes off easily with the chisel. It is more easily harvested than that of the oak, and is treated much in the same manner as the birch or willow, being seldom put upon a stage, and is generally either carted off to the tanyard at once, when dry, or preserved in stacks till sold.

In stripping the bark from any of the trees mentioned, the best time is when the young leaves are bursting from the bud. The larch, willow, and birch generally strip about the 1st of May, and the oak about the middle of the same month, much depending upon the earliness or lateness of the season.

Some larch trees yield 8 to 10 lbs. of bark per cubic foot of timber, or 6 to 7 cwt. of bark to every load of 50 feet of timber; and trees not over forty years of age may be calculated to yield 7 to 9 lbs. of bark for every cubic foot of timber.

Only two implements are used for the work after the trees are cut down, namely, the peeling iron, chisel, or tanspud, as it is variously termed, and the hand-bill or hook-bill for making incisions, and cutting the bark into lengths of about three feet. The sap in the larch tree starts very early, and the work of peeling may be begun soon after the buds begin to swell.

The bark is easily harvested, if only carried to an open, airy place, and set on end; or, which is sometimes done, hung over a paling fence, stone dyke, or rail erected for the purpose. When dry, it is carted to a loft, barn, or shed, where it is chopped up into pieces 2 inches square or thereby, and put into bags, each containing 12 to 16 stones, for the market.

The stripping or peeling is done in most parts of Scotland at about 20s. per ton; chipping or hatcheting and bagging, about 7s. per ton.

The following transactions took place either directly or indirectly under my own observation within the last few years.

Transaction No. 1. Twenty-seven tons of bark, which realised in the market £87, 2s., and cost the following:—

Peeling or tan flaying	.	£26	3	1
Chipping and bagging	. . . . .	9	5	11
Carting to railway station, and trucking		7	0	0
Railway carriage	. . . . .	19	8	2
Discounts	. . . . .	2	12	9
Incidentals	. . . . .	1	15	0
<hr/>				
		£66	4	11
<hr/>				

The sum realised was £87, 2s., and expenses, £66, 4s. 11d., thus leaving a clear net profit of £20, 17s. 1d.

No. 2. From fragmentary statements one is apt to form wrong conclusions as to the amount of bark a load (50 feet) of larch timber will yield, which the following notes will exemplify.

A conic section of a tree 20 feet long, 24 inches in girth at the centre, contains nearly 5 cubic feet of timber and 40 superficial feet of bark, each foot 1 lb. weight when dry. Of this class of trees it takes 56 (=280 cubic feet of timber) to produce a ton of bark. Another class of trees, 30 feet long, 28 inches girth in the centre—10 feet 2 inches 6 sec. cubic of timber, and 70 superficial feet of bark—32 such trees contain 326 cubic feet of timber, and yield one ton of bark. Again, a larger class of trees, 36 feet long, 56 inches girth in the centre, contains $48\frac{1}{2}$ cubic feet of timber and 168 feet of bark— $13\frac{1}{2}$ of which contain 637 cubic feet of timber, and produce one ton of bark. Again, a still larger class of trees, 45 feet long, 96 inches girth in the centre = 180 cubic feet of timber and 290 superficial feet of bark—seven such trees contain 2110 cubic feet of timber, and produce one ton of bark. The above four different sizes of trees are given to show how much bark is yielded by them, and how much more timber of the larger class than of the smaller it takes to yield the same quantity of bark, which all practical persons understand.

The tannin property of the larch is about 15 per

cent., or a little less than half that of the best oak coppice bark. The fertilising properties of larch bark are very considerable, and, according to an analysis by Liebig, it contains 2.95 per cent. of soluble salts and 97.05 of insoluble salts; the latter consists of 64.95 of carbonate of lime, 0.93 of magnesia, 5.03 of phosphate of lime, 4.18 of phosphate of magnesia, 1.04 of peroxide of iron, 2.42 of alumina, 17.28 of silica, and 1.79 of loss. A glance at these analyses will convince any farmer of ordinary intelligence of the value of larch or fir bark as a manure, especially for clay lands; and even after having served the purposes of the tanner, it constitutes an excellent fertiliser, for although it has lost its soluble salts in the process, it has gained in the acquisition of nitrogenous animal matter.

The demand for larch bark is considerably on the increase, but the price is correspondingly declining. Mr. Culbard, Elgin Tanworks, says the price of bark in 1868 was £2, 10s. per ton, and in 1877 it was £4, 15s., chopped, bagged, and delivered free at the Tanworks at Elgin.

J. M. Forsythe, forester, Cavers, Hawick, sold bark this year at £3, 5s. per ton in the rough state, equal to £3, 12s. chopped; and Mr. Scott, Tanworks, Langholm, this year gave £3, 10s. per ton, and in 1876 he paid for the same description of bark chopped, and free delivered at Langholm Tanworks, £6 per ton.

Mr. John Edward, forester, Abercainey, says: "We here dispose of a quantity of larch bark every year, but it

has of late fallen considerably in price; last year we only received £2 per ton, put on rail at our nearest station, and that, I believe, was about the current price in the district, while preceding years the current price was from £3 to £4 per ton."

Mr. James Gordon, Luss estates, Dumbartonshire, says: "Larch of small size, or such as is generally used for mining purposes, may often be profitably peeled. The process does not cost over 28s. to 32s. per ton of bark, cutting included. The bark can be carried a considerable distance to a market before exhausting the difference between its cost of preparation and delivery, and the price realised. But granting that the charge and discharge are equal, the fact of the trees being felled and divested of their branches is an important consideration; and the other fact that young trees so peeled soon lose about one half of their original weight is still more important when carriage rates are heavy. On the other hand, I disapprove of peeling large trees, or such as are to be sawn into planking or deals for constructive purposes. The bark of such trees is not so good, and besides the timber is liable to become seriously damaged from *rending*, before it can be manufactured into the required dimensions. I am therefore of opinion that larch to be used in the round state may often be profitably peeled, while larch to be used in a manufactured state should not, but should be felled at that season when the tree itself is unfit for such an operation."

Mr. J. Crabbe, Glamis Castle, says: "Although larch

bark is considerably lower in price now than it was some years ago, yet I know by experience that it still pays something considerable after clearing all expenses of peeling and delivery at the tanworks."

Mr. J. Fingland, Carronfoot, Drumlanrig Castle, says: "Peeling has been long practised, and our best sheepskin leather is tanned by larch bark. Commercially considered, barking the wood may not pay the proprietor a very high percentage, but it is a good and useful department of labour, and circulates money at home, which is an important matter for our national prosperity."

Mr. Robert M'Cutcheon, Whittinghame, Prestonkirk, says: "In regard to peeling young, healthy trees, say from twenty-five to forty-five years old, where hands are plentiful, I am of opinion that about two-thirds of recent years' market value may be a clear profit, besides about one-fourth of weight on the carriage of wood saved. The peeling of the wood causes it to rend or crack, unless it be covered from the sun, but as this description of wood is generally used for outdoor purposes, it is, in my opinion, the better of peeling, as it allows the natural sap more freely to escape."

"The bark of the larch," says Mr. T. Wilkie, Ard-kinglas, "when properly cured and delivered at the tanyard where it is to be used, realises from £3, 17s. 6d to £4 or £4, 5s. when of first-class quality, and costs about 30s. for peeling, curing, chopping, and bagging. The real profit arising from so doing is either greater

or less, according to the distance from the market, being, as it is, liable to be injured by moisture in transit. Railway companies, therefore, charge more for its carriage per ton than they do for wood. But by sea the cost is only equal to that of wood."

CHAPTER XVII.

VALUE AS A CROP.

THERE is certainly more truth in the adage, "The larch tree will buy a horse before the oak will buy its saddle," than in many others. There is no doubt but larch is the best paying wood crop that has yet been grown in this country. It can be cut and made use of at almost any age, and there is no tree better adapted for a great variety of purposes, especially for outside work.

No. 1 is a larch plantation in the county of Sussex, planted originally with the view of producing a successive crop of hop-poles, being planted amongst Spanish chestnut and ash. In clearing the crop of hop-poles at twelve years' growth, the larch selected to stand were the strongest and best, and numbered about 60 trees per acre. At the end of thirty-two years the whole of the larches were cut down, as they were found to be destroying the underwood, which was regarded as the most valuable part of the crop, and also because most of the trees had attained as high a state of perfection as the soil would admit of, it being a soft white sandy loam.

The following are the results of the crop when cut

down: sixty trees, average 30 cubic feet = 1800 at 10d. per foot, £75 :—

The surrounding ground was letting at about 20s. per acre per annum	£32 0 0
Plants (larch only) originally planted	0 10 0
Compound interest on first outlay at 4 per cent.	1 5 1
	<hr/>
	£33 15 1

It has to be noted that the sixty trees per acre selected to occupy the ground were not intended as a full crop, but only to supply what would otherwise have appeared a blank in the landscape, underwood and hop-poles being the crop most preferred.

No. 2 is a plantation in Inverness-shire, comprehending 900 acres. It was planted in 1785, and was sold standing, and cut down in 1865, being eighty years old. The planting and early history are now little known, but it may be assumed that the turf dyke with which it was enclosed would cost about £112, and the cost of plants, labour of planting, &c., about 30s. per acre; or, including cost of fence, about £1462. The thinnings throughout its growth might be worth about £10 per acre, and the crop in several parts realised fully £100 per acre.

The crop when sold comprehended about 200 trees per acre, averaging from 8 to 80 cubic feet each. The great difference of size of the trees may be accounted for from differences of soil, distance apart, some well clothed, and others almost destitute of branches.

No better proof could well be adduced of the valuable state of the trees than the circumstance that a wood merchant offered £300 for one hundred of the trees, notwithstanding the distance was fully ten miles from the nearest station on the Highland Railway. The surrounding ground is letting as sheep pasture at about 2s. 6d. per acre, while under larch it has realised 25s., minus compound interest on 32s. 6d., the original computed cost of forming the plantation.

No. 3. This is a plantation in Ross-shire containing 60 acres, planted in 1812. It was originally enclosed with a turf dyke, and planted with larch 5 feet apart. The whole expenses of enclosing, plants, and planting were about 35s. per acre. Thinning was well attended to at an early age, and fencing being required in the district, induced thinning to be carried on to the great advantage of the future crop.

The soil is dry and sandy, with a sub-soil of stones and gravel. The natural herbage is a mixture of grass and heather. The average number of trees upon the ground is, or till recently was, 136 per acre, which averaged 30 cubic feet each of saleable timber. The annual increase of wood at the present time is a little over one foot per tree, or say 1s., which multiplied by 136, gives £6, 16s. as the annual increased value per acre. The whole crop is in a very healthy condition, and the growth is likely to continue satisfactory for about eighty years, at which age, assuming the growth to continue as at present, the value would stand thus — 136 trees at present value, 30s. each = £204

per acre. Add to the above the increase of the next twenty-five years at £6, 16s. per acre, and the value at eighty years will stand thus = £374. Though within the bounds of possibility, and theoretically true, yet this will never be the saleable value, because in the nature of things some trees will become diseased, some will be blown down with the wind, and others may be damaged in various ways from storms. Its present superior value, however, is due to two principal causes, namely, suitable soil and situation, and timely thinning.

No. 4. A plantation in Aberdeenshire, comprising about fifty acres, and thirty-eight years old. It was enclosed with a turf dyke and paling, and planted at distances apart of $3\frac{1}{2}$ to 4 feet. It is inland from the sea about twenty miles, and situated at an altitude of about 400 feet. The original cost of plants, planting, and enclosing would be about £2, 5s. per acre.

The combined objects of planting were: shelter to the surrounding fields, in which it has proved a complete success; beautifying the estate; and finally, yielding a good return for the money invested.

No thinning of any importance was ever done; but nature assisted the work, by way of the largest and strongest trees overgrowing and destroying the weaker ones. The result of the plantation being left to nature was, that out of 3500 trees planted, one-third only now remain of living and growing trees; and were the plantation to stand till sixty years old,

500 healthy growing trees would be the maximum number per acre.

This plantation is probably now at its highest attainable value, when about 1000 trees per acre occupy the ground, and are worth about 1s. 8d. each, making the value per acre £83, os. 8d. Allowing £13 per acre for original outlay and interest, £70, os. 8d. remains to be divided over thirty-eight years—the medium age—equal to 37s., nearly the annual return per acre.

The ground surrounding this plantation is letting at about 5s. per acre, thus showing that certain soils planted with larch are very profitable investments, and ought to be taken advantage of when they occur. This plantation is also depastured, and for that purpose is worth at least 3s. to 4s. per acre; at same time the progressive value of the crop of wood is over £2, per acre annually, and calculated to increase.

No. 5 is a series of plantations upon an estate in the south of Inverness-shire, comprising in all about 200 acres, which may be described as one plantation. The whole was planted between the years 1817 and 1827, the oldest part being now sixty-three, and the younger part fifty-three years old. The trees were planted $4\frac{1}{2}$ and 5 feet apart. Turf dykes enclosed nearly the whole plantation, but, as already stated, being executed in detachments, nothing reliable can be given as to the actual cost. As the joint object in forming this plantation was shelter and profit, so long as it fulfilled the former and was too young to yield

the latter, no attention was paid to it by way of thinning till nearly thirty years planted, when parts were thinned for pit props; and in thinning for this purpose, instead of cutting down all the inferior growths and sickly trees, the reverse of this was practised, and in general those trees were cut which were most suitable for the market, without respect to the permanent crop. The result was that many of the slender up-drawn trees were blown down.

This manner of thinning was not continued throughout the whole extent of the plantation, hence portions of it escaped this improper treatment. At the present time this plantation is in general in a thriving state. Having a dry soil and subsoil favours it greatly. Where the trees are not in a vigorous state of growth, it is owing to the soil being too hard and impervious for the roots to run in; but where the soil is at all loose and open, the trees are growing well. The following are three respective valuations of the crop:— First valuation, 300 trees, at 5s. 8d. each = £85. Second, 240 trees, at 4s. each = £48. Third, 220 trees, at 3s. 6d. each = £38, 10s. In the first estimate those acres containing the largest number of trees are of most value, because the good trees were not cut down; and in the latter case, where the number of trees is small, the value is also small, because in thinning the best trees were cut, and the number per acre so reduced as not to leave the ground properly covered.

No. 6 is a larch plantation in Roxburghshire, inter-

mixed with Scotch firs. It was planted from 1820 to 1822, both inclusive. The plantation is situated upon the ridge of a hill extending from south to north, at an altitude between 400 and 500 feet. The soil is of various qualities, but the greater portion is of a clayey nature, resting upon yellow clay, whinstone rocks abounding in the district. The plantation extends to about 35 acres; its form is oblong—about 1300 yards long by 120 broad. It is enclosed with a turf dyke, at the time of its erection the most common fence in that part of the country.

As far as can be ascertained, the following is the cost per acre, including all expenses:—

89 yards turf dyke, at 2d. per yard . . .	£0 14 10
3000 plants, at 12s. per 1000 . . .	1 16 0
Planting the above, at 4s. per 1000 . . .	0 12 0
360 yards open drain, at 1d. per yard .	1 10 0
Incidental expenses, including carriage of plants	0 4 0
	<hr/>
	£4 16 10
	<hr/>

At forty years' growth, parts of the crop were valued, and the valuations stood thus:—No. 1, 200 trees, at 1s. 6d. each = £15. No. 2, 220 trees, at 1s. 8d. each = £18, 6s. 8d. No. 3, 190 trees, at 2s. each = £19. No. 4, 240 trees, at 2s. 6d. each = £30. From the above it will appear what progress the trees had made. The wood in each tree is calculated at 1s. per cubic foot, so that the largest average did not exceed five feet, which is a small increase compared with the growth of many larch plantations. The deficiency of growth may be accounted for from the

stiff clay soil, cold subsoil, and neglect of timeous thinning.

No. 7 is a tract of larch in Ashdown Forest, between East Greenstead and Rotherfield, in the county of Sussex. One part, comprising about 300 acres, is worthy of special description.

The larches here, and generally all over this part of the country, are planted from 2 to $2\frac{1}{2}$ feet apart, and allowed to remain at that distance till about twelve to fourteen years old; at the latter age, about three-fourths of the crop are cut down for hop-poles, leaving the remaining one-fourth to grow up as a crop of timber. The result of this severe thinning is injurious to the remaining crop, even in England, and would probably be fatal in Scotland, with a colder climate.

The difference of growth is not due to the shape of the tree, but to the branches situated near the base of the trunk, which supply the roots with nourishment.

Several circumstances tend to the success and rapid growth of these plantations: the distance from the sea (twenty miles); altitude, 400 to 500 feet; soil, dry, open hazel loam, resting upon iron ore; free, open exposure; and no mixture of evergreen trees. The variable state of the soil manifested itself here in the following ways:—In one place a poor white sand prevailed, upon which the trees were all “pumped,” and their growth nearly over. In a few places clay prevailed, and hereupon the dead stocks showed that the trees had died at about fifteen years’ growth. “Moor-pan”

was found in some parts, and where the trees came in contact with it, the growth had ceased early, and those still living showed a general rigidity and stuntedness of growth.

The only apparent difference between larch grown in the South of England and the North of Scotland consists in the rapidity of their growth in the former country, and attaining maturity at an earlier age. Eighty years may be the maximum age for a larch plantation in the county of Argyle or Ross-shire, and fifty the maximum age for plantations in Sussex, Surrey, or Kent.

The following are a few valuations of different small plantations in Ashdown Forest:—No. 1. Trees, fifty years planted; soil, dry gravelly loam, with gravelly subsoil; exposure east, sheltered from south and west; 300 trees per acre; average contents, 20 cubic feet: 6000 feet at 10d. per foot = £250. No. 2. Age of trees, forty years; soil, light hazel loam, sand subsoil; 400 trees per acre; average contents, 10 cubic feet: 4000 feet at 10d. per foot = £166, 13s. 4d. No. 3. Age, thirty-five years; soil, sandy loam; 400 trees per acre, containing 6 cubic feet each, at 10d. per foot = £100. No. 4. Age, forty years; soil, light moorland, open dry bottom; 500 trees per acre; average contents, 4 cubic feet: 2000 feet at 10d. per foot = £83, 6s. 8d. No. 5. Age, thirty-two years; soil, clayey loam; subsoil, white sand; number of trees per acre, 60; average contents, 30 feet: 1800 feet at 10d. per foot = £75.

The following is an example given of the value of a crop of larch in the county of Huntingdon, the property of His Grace the Duke of Bedford. This plantation was originally a very large one and the first planted upon the estate, but the part to which the annexed statements apply composed the last part of the clearing, twelve acres, at fifty years old. The plantation was sold in 1864, and realised the following amount, stated thus:—

1300 trees, containing altogether 10,000 cubic feet, at	
1s. 2d. per foot.	£583 6 8
And 43 tons larch bark at 40s. per ton	86 0 0
	<u>£669 6 8</u>

Or thus:—£669, 6s. 8d. ÷ 12 acres = £55, 15s. 6½d. per acre.

The following is a statement of some interest upon the cultivation of larch grown on the Duke of Bedford's estate in Northamptonshire, parish of Thornhaugh:—

The plantation comprises an area of 55 acres, upon rather stiff but dry soil, resting upon limestone rock. This enclosure, previous to cropping with larch, bore a crop of oak and ash, which was cut down and the ground trenched and replanted.

It was planted with larch at the rate of 4000 trees	
per acre, and thinned at twenty-three years old,	
yielding to the amount per acre of	£10 14 0 *
The expense of thinning was 18s. per acre—deduct .	0 18 0
	<u>£9 16 0</u>
Standing upon the ground after thinning, 1000 per	
acre, at 1s. 6d.	75 0 0
Net value of crop per acre at twenty-four years' growth	<u>£84 16 0</u>

Expense of trenching the above, per acre.	£16 0 0
Plants and planting cost	5 8 0
Incidental expenses	1 0 0
	<hr/>
Total cost per acre	<u>£22 8 0</u>

By those interested in the growth of larch, an account of His Grace the Duke of Athole's forests will be gladly received. Various statements regarding the Duke of Athole's larch forests are already before the public. A very full account of them was published in the "Transactions" of the Highland Society for 1832, from which the writer has taken some extracts. Forty-eight years have elapsed since the account referred to was published, hence great and important changes have taken place since then. To give anything like a detailed account of the above forests would occupy space far beyond the limits at command. Nothing, however, will be withheld that is considered sufficiently important to prove of practical value to those interested in the culture of the larch.

His Grace John, third Duke of Athole, planted in various ways 410 acres between the years 1759 and 1774, the greater part of which were cut down several years ago, at various stages of perfection, and in general they proved remunerative. A large enclosure was planted near Blair Athole between the years 1777 and 1782. Thinning was attended to when about twenty years planted, but in this case it was evidently too long delayed. The trees in this plantation were planted between five and six feet apart, and, as a natural result, some of the trees died when young,

which gave the surviving ones double advantage. Some of the trees so favoured now contain 75 cubic feet of timber and upwards, and are from 80 to 90 feet in height, while the average trees, though quite as tall, contain only about 25 cubic feet.

This plantation is now partly cut down, hence it cannot be properly valued; but twenty years ago it contained an average of about 200 trees per acre, at 25 cubic feet each = 5000, which at 1s. per foot amounts to £250 per acre, being the maximum value it was capable of attaining. The plantation as it now stands is worth about half the latter sum.

Loch Ordie and Loch Hoshnie plantations or forests may be regarded as one, or at least described here as such, being all within one boundary, and in most other respects much the same. The combined contents of the two plantations amount to 5190 Scotch, or 6545½ imperial acres—the largest larch plantation, probably, in Britain. The planting was completed in eleven years, having been commenced in 1815 and finished in 1826, and is perhaps the greatest undertaking in the way of planting ever executed by one person. The total number of larches planted upon the estate between 1738 and 1826 amounted to 14,096,719 plants, which, at the rate of 2000 plants per acre (some of the ground only 1200 per acre), covered an area of 10,324 imperial acres.

The instructions were to plant larch (alone) at distances apart of six feet; but these instructions seem not to have been attended to, as at the present day some

of the trees are still growing within four feet of each other (from centre to centre). This, however, is more the case at Loch Hoshnie than at Loch Ordie, and may be accounted for in various ways. Loch Hoshnie being an out-of-the-way place, and far distant from the home of the inspector (Mr. M'Crosty), the planters may have been less assiduous. The ground being moory, poor, thin, and cold, failure to some extent at least might have been anticipated. Be this as it may, the orders from His Grace were to plant six feet apart.

The earliest planted portion—that at Loch Ordie—now sixty-five years old, is a very fine crop of larch, but must be seen to be duly admired. A hundred acres or more may be met with in one place where the trees bear a marked resemblance to each other in straightness of trunk, with a gradual but imperceptible diminution of girth from the base to near the top, cleanness of stem, as if polished by the hand of art, to a height of 30 to 40 feet and upwards, where a light canopy of drooping spray crowns the elegant column. The trees, according to altitude, vary in height from 50 to 70 feet and upwards. The bark is peculiar. Where the ground is dry, it is of a reddish-grey colour; where somewhat damp and sheltered, it is light coloured, almost to whiteness; and when situated at a high altitude, and where the soil is damp or wet, the trees are covered with moss and lichens, presenting quite a hoary and shaggy appearance.

The rule of six feet distant planting has been more

strictly observed on some of the hillsides around Loch Ordie than in most parts of the forest. In some instances the trees are yet standing at the same distances as when planted, showing that they had not at any time been thinned. On such parts the value of the trees is three-fourths less than where they had been thinned when about or before twenty years old. Not only is the *present* difference in value in favour of timeous thinning, but the older the trees grow the difference becomes still greater. At fifty-two years old the thinned part is worth 8s. per tree on an average, while the unthinned part is worth only 2s. per tree. Allowing the plantation to stand till eighty years old, the difference in value, as indicated by the present proportional growth, will then be—the thinned trees 35s. each, and those unthinned 5s. each. In other words, the unthinned trees at fifty-two years old are worth only one-fourth that of the thinned ones, while their prospective value at eighty years old will be only one-seventh.

Though the individual trees differ in value seven-fold, the value per acre does not so differ. The unthinned parts, six feet distant, contain 1200 trees per acre, at 5s. per tree = £300; and the parts thinned out to double that distance contain only 302 trees per acre, at 30s. each = £472,—thus making the true value of an acre thinned out to half the number planted at six feet, between one-fourth and one-fifth more value than the part left standing at the distance planted. At the end of eighty years there is a balance

in favour of thinning over not thinning to the amount of £172 per acre.

The above calculations show the proportional rather than the true increase and value of the wood. In consequence of the want of thinning till the lower branches had withered and died, the trees lost the means by which their growth was promoted, and which under the best after-management could never again be restored.

On examining the concentric rings or layers of wood of a number of trees in various parts of the forest, where they were cut and laid in heaps upon the roadsides, it was quite observable where the proper period of thinning had been exceeded. Most of the trees planted at from five feet to six feet apart had made annual layers of wood from one-sixth to one-fourth of an inch thick till about twenty years old, about which time the branches met each other, and thus excluding light and air, speedily destroyed their vitality. After this occurred the growths annually decreased, and by the thirtieth growth, in many cases, instead of making annual layers of one-sixth to one-fourth of an inch in one year, one-fourth of an inch was only made in four or five years. With these facts before us, the urgency of thinning at the proper time, in order to keep vital the lower branches, must appear natural and reasonable to any one acquainted with the laws of vegetation. The important function of the lower branches to trees of any age (but especially young ones) is too little regarded. By the

lower branches the roots are nourished and fed ; by the latter the sap is absorbed and conveyed to all parts of the tree ; and just in proportion to the healthy and proper condition of the roots is the whole structure of the tree supplied with wood-forming materials.

The crop of this immense forest may average 200 trees per acre, and the average market value may be 6s. per tree, thus making the value £60 per acre. Doubtless many acres are worth more than this, but others are worth less, so that £60 per acre may be considered a fair average of the whole. The fencing, planting, &c., of these forests are stated to have cost something less than 30s. per acre, detailed thus:—

2000 one-year transplanted larch, at 7s. 6d. per 1000	£0	15	0
One man two days, at 2s. 3d. per day . . .	0	4	6
One boy carrying plants, at 6d. per day . . .	0	1	0
Enclosing, at the rate of 5s. per acre . . .	0	5	0
• • Clearing juniper, draining, &c.	0	4	0
	<u>£1</u>	<u>9</u>	<u>6</u>

The success of these forests will bear favourable comparison with any in Scotland, and yet it is very evident that much can be learned from points of failure as well as success ; and with the additional experience of half a century, it is strange that so very little advancement has been made in the growth and culture of larch. The undulating nature of the ground favours the growth of larch in the Athole forests. It is well understood how readily water runs off a hill face, and how soon not only its herbage, but its soil, becomes dry after rain or melted snow, com-

pared with level ground. Much of the *soil* in the Athole forests is too clayey and wet for the proper growth of larch, and but for the sloping nature of the ground would fail to grow it at all, or at least to valuable dimensions. The soil, therefore, though too stiff and wet to grow larch on flat ground, will nevertheless grow it comparatively well upon an inclining surface.

Again, the Athole forests are far inland and beyond the influence of the sea, an advantage which many districts, otherwise suitable, do not possess.

On elevated grounds the effects of frost are little felt compared with low and damp situations, and in this respect also the Athole larch (with few exceptions) enjoys an advantage few others possess.

The great extent of forest, too, contributes its beneficial influence by modifying and softening hard blighting winds, which greatly damage the foliage in early summer; the irregular surface of the ground (hill and vale) also acts in a similar way.

An immense advantage given to the Athole larch forests was the distance apart at which the trees were planted. It is true, close planting and early thinning will accomplish the same end, but it rarely happens that thinning is done in time to prevent the death of the lower tier of branches. As well may we expect an animal to be healthy and thriving with only one lung, as look for a tree to be so with only a few branches at the top. The plants were in general small, and were planted without burying the roots too deep

—a very prevalent error in modern planting, and one which should be very carefully avoided.

No importance seems worthy of being attached to the rock formation; the trees grow equally well upon all the different rocks, provided only there be open fissures and crevices for the roots, and the ground dry—all which advantages the Athole larch possesses in an eminent degree.

- The practice of keeping down rank and luxuriant weeds, including juniper, whins, brackens, and grasses, for several years subsequent to planting, tended greatly to promote the prosperity of the young plantations, and is a practice worthy of imitation.

Another circumstance—regarded by some as the most potent of all—in rendering the Athole larch so pre-eminently successful, was the seed, most of it having been imported direct from its native mountains in Italy or Switzerland. Whether this be of vital importance or not has not yet been fully established; but one thing is certain, that the first plants introduced have not been surpassed in growth by those raised from seeds from trees acclimatised in this country or from Tyrol. Again, the fact of the oldest larches at Dunkeld and Blair having been grown in the London nurseries, and even grown and treated as exotics, was in no way prejudicial to their future success.

The forest operations are conducted under one general manager, with a staff of subordinates to carry out details.

The wood is generally disposed of to wood mer-

chants in the growing state, who cut and manufacture it themselves. The prices (abating bark) were from 1s. to 1s. 2d. per cubic foot, 1s. being the general selling price. Much of the wood in the form of thinnings being too small to admit of being sold by measurement, is sold by the tree or number of trees instead.

Having briefly described the soil, condition of the crop, its value, &c., we shall next proceed to indicate certain conceived defects, feeling justified in doing so by the loud and earnest demands of rural progress and enlightenment of the age.

First, Much of the soil is too stiff and cold, and surcharged with water; hence the results of slow growth, &c. *Second*, The commencement of thinning had been too protracted, and evidently, in some cases, also continued till overdone. *Third*, Considerable portions of ground are under larch which should have been under oak, silver fir, Norway spruce, and Scotch pine, thus giving rise to the unjust complaint of "failure of the larch."

His Grace, who was perfectly aware that larch would not grow on every description of soil, says: "It is an error to suppose that the larch will thrive on all soils and in all situations. There are many kinds of soil in which it will not thrive and ought not to be planted. It has been found that larch cankers in wet situations, and contracts heart-rot in wet subsoils. In cold and damp situations it becomes fogged and covered with lichens." The Duke's observation and experience in these matters entirely agree with our own, and are

forcibly confirmed by what is to be seen throughout the forests in which he took such delight and deep interest, and from which he won unprecedented fame, thereby endearing himself to all true lovers of sylvan grandeur and magnificence.

Under all circumstances, the Athole larch forests have succeeded admirably ; and considering that the planting was in a manner experimental, the result may justly be regarded as a success.

° Mr. Brown, a modern writer of considerable eminence, and whose authority in general arboriculture is of no small weight, gives as the result of his experience of a plantation in Midlothian, at sixty years old, a *clear profit* of £509, 17s. 4d. per acre. Another author, still more modern, gives also as his experience a statement of a larch plantation, at forty years old, yielding a clear profit of £548, 15s. per acre.

•• In the light of the preceding statements, persons finding their larch plantations falling far short of them are led to think and speak of their own as a failure. The writer may here state his own experience on the subject. He has not found any considerable crop of larch come within fifty per cent. of the preceding statements ; although, at the same time, he believes that he has seen as good larch plantations as are to be found in Scotland, and which may be justly considered quite successful productions, and pay at least equal to any other crop the soil produces. Very few writers who make a prospective statement of the value of a crop of larch take into account all the impending

circumstances ; hence the many false conclusions. It is only by present observation of what is *an existent crop upon the ground* that a true knowledge of its value is ascertained.

Mr. J. Stewart, Inveraray, says : " As a commercial product, I have no hesitation in saying that a larch plantation of any given number of acres will, at the end of say from fifty to sixty years, be worth double the value that the same number of acres of any of the other coniferous tribe will be worth. That is to say, if due care is observed and taken that the larch is planted in suitable soil and situation.

" I have planted a considerable extent of larch on this estate since 1848, and the plantations are all thriving very well. From the plantings of 1849 and 1850 I now get two lengths of 9-inch and 10-inch sleeper blocks.

" I may mention a young plantation of about 120 acres, planted in the spring of 1873, in irregular clumps of larch and Scotch fir. In the low and sheltered parts of this plantation some of the larch trees are now 25 feet high, and thriving remarkably well."

Mr. James Crabbe, Glamis Castle, says : " In a plantation here of 315 acres, there are growing on one side of a ravine near the village of Glamis, on the space of 1 acre 3 roods, among a few beech trees, fifty-four larches from 110 to 126 feet high, 112 years old, and on an average each tree contains 105 cubic feet of timber, which at the present price (1s. 6d. per foot) are worth £7, 17s. 6d. each, equal to £425, 5s. The largest tree in the group girths, at five feet from the

ground, 8 feet 2 inches. I have never seen anywhere an equal number of trees so tall, straight, and well grown all in one place, nor has any one to whom I have shown them, and many have come from afar to see the sight." He also says: "The last sale we had of the thinnings of a mixed plantation forty-five years old was in 1877, at which sale the larch brought from 7s. 6d. to 20s. each, and the Scotch pine only 1s. 6d. to 3s. I consider larch to be the most profitable crop that can be planted, where the soil is suitable, notwithstanding a few, or even many trees, are attacked with blister or aphis at one or other of their stages of growth."

On the estates of the Earl of Airlie there are to be seen some very fine forests of larch about sixty years old, and also on the estate of Banff (Sir James Ramsay, Bart.) some fine forests, although of late a great extent has been cut on all the districts.

"In 1863, 1864, and 1865," says Mr. T. Wilkie, "I manufactured 272 acres of wood, growing at altitudes ranging from 350 to 700 feet, the crop of which consisted of larch and Scotch fir. The total cost of this lot was £7000. The larch were valued at 15s. per tree over all; while various valuations were put upon the Scotch fir, according to size. The larch then sold at 1s. 10d. for the first class, and from 1s. 8d. to 1s. 6d. per cubic foot delivered, for the second and third qualities. Several trees in this lot reached 100 feet in height, and measured from 50 to 95 cubic feet, the latter being consequently sold for about £7 per tree."

Mr. R. Murray, forester, Innescara, County Cork, Ireland, says: "There was recently sold on this estate a larch plantation of fifty acres, thirty-seven years planted, containing 250 trees per acre, at £70 per acre, equal to about 5s. 7d. per tree. The trees averaged about eight cubic feet, but a considerable portion of them were beginning to decay in the heart."

The estate of Durris on Deeside is splendidly wooded, and comprehends about 5000 acres of plantation, of which a large portion is larch, which, on all the dry and suitable ground, is growing remarkably well. In confirmation of this may be cited the circumstance, that on the ever-memorable night of the Tay Bridge disaster over 700 larch trees were blown down, forty years planted, and were sold in the plantations at an average of 8s. per tree, which was a high price considering that blown trees invariably realise less than growing ones.

In 1792 a plantation was formed on the north side of the Hill of Fare, near Midmar Castle, Aberdeenshire; and when cut down in 1875, the trees contained from 70 to 80 cubic feet of the finest quality of timber, quite sound and healthy.

In 1825 a plantation was formed on Monymusk estate, consisting of larch and Scotch fir. The larch is now fully two-thirds more value than the Scotch fir, and making wood very rapidly; the larches contain on an average eight cubic feet of clean, well-grown timber.

CHAPTER XVIII.

AS A HOP-POLE CROP.

ABOUT twenty years ago no crop of wood grown paid the proprietor, or even a farmer with a nineteen years' lease, so well as a crop of larch hop-poles. When the plantation was designed to be permanent, the ground was planted with Spanish chestnut or ash, or a mixture of the two, as the soil and other circumstances suggested, at four feet apart each way, and the ground filled up with larch to two feet apart each way. Thus 2722 hardwood plants and 8168 larches occupied the ground, making a total of 10,890 plants per acre. The plantations thus formed, which were usually on arable land of secondary quality, were kept clean by hoeing for three years or thereby, after which no attention was paid to them beyond keeping them well fenced to prevent sheep, cattle, and other animals from injuring the plants.

At the age of sixteen, seventeen, or eighteen years, according to growth, the whole plantation was sold by auction or private tender, and every tree, including ash and chestnuts, cleared off the ground, and cut by the purchasers according to specifications and conditions of

sale, which were, to cut all the hardwoods four inches above the surface of the ground. The sums realised for such plantations varied from £40 to £60 per acre, and frequently paid the wood merchant well at the latter sum. In the county of Sussex, in 1854, the prices realised for larch hop-poles were as follows:— 10-foot poles, 20s. per 100; 14-foot poles, 30s.; and 18-foot poles, 40s. per 100. It must not be inferred that all the 8168 larches planted attained hop-pole size, or to any value at all, except as faggot-wood for burning in tile-kilns, &c., but the above prices indicate the value of the larch as a hop-pole product, which is usually twice that of any other description of wood, except Spanish chestnut, which is next in value to larch as a hop-pole.

Small larch rods are very valuable for a variety of purposes, such as securing thatch on houses, stacks of corn and hay, &c. For garden and nursery purposes it is also much used for training trees, stakes for rasps, hollyhocks, and dahlias; but for these purposes small wood of other descriptions at a cheap rate is generally used, and therefore it is not commendable to grow larch for these minor and subordinate purposes, notwithstanding that it answers well in its application.

As larch, from its durability when young, is found to yield the most profitable description of hop-poles, in rearing plantations exclusively for that purpose, no other tree should be planted amongst it, as it always, when well grown, brings the highest price in the market.

There are two modes of growing the larch for hop-poles. One is to plant the young trees at distances varying from 18 to 30 inches apart, according to the size of poles wanted, and to let them grow undisturbed till they are of the size wished, and then they are all cut and disposed of at once. The other mode is to plant the young trees at 18 inches apart, and when they have arrived at a stage suitable for the smaller size of poles, to thin out each alternate tree, and leave the others to grow for some years, until they are fit for the larger sizes. Either of these modes may be adopted, according to the class of poles that may be found most in demand in the locality. In Woolmer Forest and its neighbourhood large quantities of young larch are reared for this purpose, and they are planted, some fields at 18 inches apart, others at 20 inches, others at 24 inches, others at 30 inches, and others at about 3 feet apart—all depending upon the character of the poles it is wished to grow, whether of a small or large size; of course, the smaller the poles are required, the closer the trees are planted.

There is no class of tree crop more simple of cultivation than this, as the only point aimed at is that of obtaining the largest quantity of clean, straight poles from a given piece of land, and this is attained by planting the young trees close, in order that they may draw up one another to the desired height and thickness.

It is often found desirable to rear several crops of this sort in succession on the same piece of land, and

where this is an object with the cultivator, it is requisite that the land should be ploughed or trenched at the outset, as by doing so the young trees will grow more rapidly, and therefore be fit for the market several years earlier than if they had been planted on uncultivated land; and, of course, from this a great advantage is gained in point of time. In preparing the same piece of land for a second crop of hop-poles, it should be again trenched—and all the roots taken out in the operation—about 18 inches deep, so as to bring up new soil and bury the old surface. This done, a corn and green crop should be taken from it after manuring, when it will be again in a fit state to grow a second crop of poles, which, from being planted on manured land, will grow rapidly and repay any extra outlay. This may be done successively, one crop after another, for any reasonable length of time, as it is not timber that is wanted, but poles from ten to twenty feet in length, and three inches diameter at base.

The culture and treatment of larch as a crop for hop-poles differ in almost every respect from that of timber, and therefore what is recommended in regard to manure and trenching as beneficial to the former is to be regarded as hurtful to the latter. Manures stimulate and force a rapidity of growth up to a certain limited age, after which the trees begin to fail in growth, and shortly afterwards die off. Therefore, although manures may, on certain soils, benefit a crop of larch as hop-poles, it by no means follows that it

will equally benefit a crop of timber that requires fifty or sixty years to attain maturity.

No. 1 was a larch plantation in the county of Sussex, grown entirely as a crop for hop-poles, which was sold by public auction in the month of November 1855, after having completed its fourteenth growth. The plantation comprehended about eleven acres, and was divided into five lots, which were sold at prices varying from £60 to £70 per acre. Allowing £65 as the average price per acre, the following are the returns, after cutting and conveying to market when partially dried:—

1400 10-foot length hop-poles, at 20s. per 100	. £14 0 0
1500 12-foot length hop-poles, at 25s. per 100	. 18 15 0
1000 14-foot length hop-poles, at 28s. per 100	. 14 0 0
2500 16-foot length hop-poles, at 32s. per 100	. 40 0 0
1600 18-foot length hop-poles, at 40s. per 100	. 32 0 0
	<u>£118 15 0</u>
Purchase money per acre	. £65 0 0
Cutting and clearing the wood	10 0 0
Carriage to market	. 20 0 0
Merchant's profit	. 23 15 0
	<u>£118 15 0</u>

Against the above sum there is a charge of £21, 3s. for plants, planting, keeping down weeds, and interest, thus leaving a profit of £43, 17s., which, divided by 14, the number of years' growth, gives £3, 2s. 7½d. to the proprietor; and similar ground (including this) before planting was let at not more than 25s. per acre,—therefore there is a clear balance in favour of planting of £1, 17s. 7½d. per acre during the time it was under crop.

CHAPTER XIX.

AS AN IMPROVER OF PASTURE LANDS.

THERE are great differences of trees for shading and otherwise injuring crops, grass, and other vegetation growing underneath them. "The larch being a deciduous tree," remarks Sir Thomas Dick Lauder, "sheds upon the earth so great a shower of decayed spines every succeeding autumn, that the annual addition which is made to the soil cannot be less than from a third of an inch to half an inch, according to the magnitude of the trees. This we had frequent opportunities of proving by our remarks made on the surfaces of newly cleaned pleasure walks." The Duke of Athole says: "The *Holcus molis* and the *Holcus lanatus* are the plants which begin to spread a sward over the ground, and this first pasture goes on continually improving." He also said that he "found the value of the pasture in oak copses was about 5s. or 6s. per acre in every twenty-four years, when the copse is again cut down. Under a Scotch fir plantation the grass is not worth sixpence more than it was before it was planted. Under beech and spruce it is worth less than it was before. Under ash the value

may be 2s. or 3s. per acre more than it was before planting. But under larch, when the ground was not worth 1s. an acre before planting, the pasture becomes worth from 8s. to 10s. an acre after the first thirty years, when all the thinnings have been completed, and the trees left for naval purposes at the rate of about 400 to the Scotch acre, and twelve feet apart." So impressed was the Duke with the value of larch as an improver of natural pasturage, that he makes a statement to show that the improvement of the pasture alone, without the timber at all, is sufficient to encourage and warrant all the outlay. The Duke has also left behind him some very interesting documents as to the great fattening properties of the pasture of larch woods.

Much has also been said as to the milk-producing properties of the larch, and in order to make sure of the subject, I have made special inquiry at persons having cows depastured in larch forests, and they invariably state that the milk is of excellent quality, but not so much in quantity as when the cows are in the open field, or pastured where there are no trees. Sir Thomas Dick Lauder makes also a mistake as to the fertilising and enriching properties of the leaves, for while they do cover the ground to some extent when newly shed, yet when fairly decomposed and rotten, the enriching and manuring properties are scarcely perceptible. The larch also certainly tends to kill and eradicate heather, but not more so than the Scotch fir, and certainly much less than the Norway spruce.

The greater part of the Athole larch forest is depastured with blackfaced wethers, kept over winter and the succeeding summer, and sold next autumn, having been kept twelve months. This mode of consuming the plantation grass is profitable, and adds very considerably to the revenue from the woods and forests. In conversation with the shepherds' wives, they informed me that though their cows do very well in the forests, yet they produce more butter, by at least one pound per week, when grazing on open pasture. The butter, however, is admitted to be sweeter and of richer quality produced under the larch. It is to be regretted that considerable portions of larch forests are in too wet a state to be judiciously grazed with cattle, their footprints forming basins for the water to stand in, to the injury of the roots of the trees; and therefore it is much better to depasture with sheep wherever the ground is soft and wet.

CHAPTER XX.

ORNAMENTAL EFFECT.

FORESTRY may very well be divided into two classes or descriptions, namely, ornamental, which embraces everything that pleases the taste, and useful, which comprehends money value as a commercial or industrial article, and shelter, shade, amelioration of climate, and whatever contributes to the welfare of man, directly or indirectly. To produce ornamental effect, both the trees themselves and their distribution, position, &c., must be such as to please the taste of those who are privileged to enjoy them; and to accomplish the object of usefulness, efforts of the requisite kind must be directed to that end.

The term "useful forestry," as distinguished from ornamental, may be defined as the art and practice of growing the greatest quantity of the most valuable wood or timber upon the smallest space of ground in the shortest period of time. These conditions require to stand connected, and none of them will suffice by itself. To grow the greatest quantity of wood might not be of much advantage if of inferior quality. Quality, again, would not avail much if the ground to be grown

upon were too great in area, thereby entailing ground-rent too high for the profits. Time also represents money or expense, and it is therefore made a condition that time be limited for the growing of the crop. Larch of all others has been designated "the profitable tree," and well it may; for although it has defects and shortcomings, as every other tree in the forest has, it is yet the most profitable tree that is grown in this country. It attains maturity in less than half the time oak does, lasts as well for any purpose outdoors, and in some cases equally as long indoors, and commands within a fraction as high a price, taking young and old wood together, and every other item of expense connected with both. And again, while the use of oak in shipbuilding is being greatly displaced by iron, yet for fencing and architecture larch is daily increasing in demand.

Ornamental forestry includes everything relating to trees that please the eye; and since "man is not to live by bread alone," it follows as a natural result that, much as he requires to supply his physical wants, he yet requires as much to feed the mind. The larch tree, however, although found at present in prominent places near many domains, the noblest and best in the land, is not to be considered an ornamental tree in the general acceptance of that term, and will never bear comparison in such situations with the oak, elm, beech, or sycamore. Young larches are beautiful at every stage of growth, either in the nursery or out of it; those of middle age and size are graceful

and lovely when in full leaf, even as the birch or willow. In mature old age, however, it spurns and divests itself of all elegance and gracefulness, and not unfrequently assumes the picturesque, unique, rugged, and sometimes even the grotesque. As we claim the right to say, "Some things are lawful but not expedient," so may the larch say, "I am the right and proper tree, and may lay claim to any situation in the domain, yet to me all situations are not eligible."

The larch is (not excepting the Scotch pine) probably the most valuable of its tribe. The name seems derived from the Celtic *lar*, fat, in allusion to the resinous juice which it exudes. Dioscorides remarks that *larix* is the Gaelic name for resin. Though a native of the mountains of more southern regions, it thrives uncommonly well in Britain; and as it grows more rapidly, and also in more varied soils than the other, it is perhaps better adapted for general cultivation. In the south it attains an immense height, some single beams of larch employed in the palaces and public buildings of Venice being said to be 120 feet long. Even in the plantations of the Dukes of Athole and Argyle, and other properties in Perthshire, Argyleshire, &c., some larches are considerably over 100 feet high. The wild alternation of hill and valley in these counties, with the general opening of the glens and exposure of the surface to the south, seem to afford the larch a situation something like its native locality in the Tyrolese and Dalmatian Alps; for though other trees, and some of them fast-growing ones, such as the

spruce, have been planted at the same time, the larch outgrows and overtops them all; and in summer, when it is in the full luxuriance of its leaves (which are a bright clover green), it rises over the dark forest like an obelisk of beryl. It also sheds its leaves, and is probably by that means saved from those keen winter blasts that prove so destructive to pines. Even when naked it is an ornamental tree. The trunk is generally straight, tapering gradually to a point; the branches, which are rather small in proportion to the tree, taper up in the form of a perfect cone; and the whole either of a lively brown streaked with yellow, or one golden glow of spiral turrets, towering high, till hid in the mountain cloud.

CHAPTER XXI.

EXAGGERATIONS ABOUT LARCH.

THE larch, like everything of importance, has undergone many criticisms, some favourable, others unfavourable; some extolling it, others condemning it; some showing it as adapted to and fit for almost everything, others pointing out its uselessness and unfitness for almost anything. Like fashions in other things, the fashion in larch has changed; at one period its praises were loudly sung, at another it was decried and denounced. At one period the cry is, "Plant larch, and nothing but larch;" the next, "Do not plant it at all, unless to bring disappointment and ruin to the proprietor."


"Nothing," say the oracles of one period, "pays so well as larch." "Nothing," sounds the trumpet of another, "is so utterly ruinous as the foreign intruder." Would-be prophets, too, have prophesied regarding it, one predicting its universal adaptation as the tree of all others to plant on all lands, good, bad, and indifferent; another uttering a warning voice against planting it at all, and predicting its extinction as soon to be an established fact. In the "*Rural Cyclopædia*,"

edited by Rev. John M. Wilson, I read as follows :—
“It is so very generally useful, and so often pre-eminent, that the many purposes to which it may be advantageously applied almost defy enumeration. Even Hanbury says many encomiums have been bestowed on the timber of the larch, and we find such a favourable account of it in ancient authors as should induce us to think it would be proper for almost any use.”

Certain it is that this is an excellent wood for ship and house building. At Venice the wood is often used in building houses, as well as in Switzerland, where these trees abound; and without doubt the larch excels for ship-masts, beams for houses, and doors, windows, &c., particularly as it is said to resist the worm. In Switzerland the houses are covered with boards of this wood, cut out a foot square; and as it emits a resinous substance, this resin so diffuses itself into every joint and crevice, and becomes so compact and close, as well as so hardened by the air, as to render the covering proof against the weather. The wood when first laid on is said to be very white, but this colour changes in two or three years to black, which then appears like a smooth shining varnish. Its merits are stated to have been known as early as the time of Julius Cæsar, who calls it *lignum igni impenetrabile*. But the merit of making known its valuable properties as a timber tree for the climate of Britain is due to the Duke of Athole.

The first larches brought to Athole, as already stated,

were from London by Mr. Menzies of Migeny in 1736 or 1738. Five were left at Dunkeld and eleven at Blair in Athole, as presents to the Duke. Of the five planted at Dunkeld three have been cut down, two of which were felled in 1809, one measuring 147 cubic feet, and the other 168 cubic feet. The third one, as stated at page 18, was cut down in a frolic, or through a capricious whim, to the no small sorrow of the worthy proprietor. The last mentioned was sold on the spot to a shipbuilding company in Leith at 3s. per cubic foot, or £25, 4s. for the tree. The other two larches are of immense size, and continue to grow on the lawn at Dunkeld. The popular account that the trees at Dunkeld were the first larches that were introduced into Scotland, and that they were imported from Italy with other exotics, and nursed in a hot-house, is believed, by those entitled to know, to be quite authentic. There are various traditions about the Dunkeld larches, but I got my information from the son of a man who lived on the spot (James Hay), and was employed on the estate at the time, and I have no reason to doubt its accuracy. The Duke, who was perfectly aware that larch would not grow on every description of soil, says, "It is an error to suppose that the larch will thrive on all soils and in all situations. There are many kinds of soil in which it will not thrive, and ought not to be planted. It has been found that larch cankers in wet situations and contracts heart-rot in wet soils. In cold and damp situations it becomes fogged and covered with lichens."



The Duke's observation and experience in these matters entirely agree with our own, and are confirmed by what is to be seen every day.

The Athole forests are the largest in Britain (of a private kind), the entire area being about 10,324 imperial acres, and the trees planted upon it 14,096,719. All the larch plants the Duke was able to obtain between 1774 and 1783 amounted only to 279,000, and cost (two years transplanted) 6d. per plant. After that date the price of plants (two years transplanted) fell from 6d. per plant to 35s. per 1000.

One cause of disappointment, as to the pecuniary returns of the larch, arises out of the circumstance of too much having been expected of it. In a report on the Athole larch, it is stated that the Duke expected to realise £1000 per acre. Suppose, says the report, the plantations are thinned out when thirty years old to what they are to stand for ship timber—that is, 400 trees per Scots acre = 315 per imperial,—suppose after that period the above were cut down at the following respective ages, the value of the whole per acre at the different periods would be as follows:—

400 trees thirty years old at 2½ cubic feet each tree	
= 1000 cubic feet, or 20 loads at 1s. 6d. per foot	£75 0 0
400 trees forty-three and a half years old at 15 cubic feet	
each tree = 6000 feet, or 120 loads at 1s. 6d. per foot	450 0 0
400 trees fifty-nine years old at 40 cubic feet each tree =	
16,000 cubic feet, or 320 loads at 2s. 6d. per foot	2000 0 0
400 trees seventy-two years old at 60 cubic feet each tree	
= 24,000 cubic feet, or 480 loads at 2s. 6d. per foot	3000 0 0

The average of these prices would be £1381, 5s. per

acre, so that £1000 per acre is not too high a calculation. It is needless to say the above calculations were to a great extent conjectural rather than matter of fact, and the prices realised were estimated at more than double what are now obtained. Perhaps the greatest evil that results from such extraordinary statements is, that they raise expectations which are sure to be dashed to the ground, an ordeal which no one likes to be subjected to.

At one time, and up to about 1845, no larch herring barrels were allowed by law to be made use of, but now larch is known to be so good for that purpose that it is more used than any other wood. At one time it was thought to impart an unpleasant taste to the herrings, but now it is considered that it greatly improves their flavour. It was also said to be so porous that it did not retain the brine, but now it is found to retain it better than birch or alder, with the additional advantage of having no black knots, which render staves quite useless for retaining brine.

At Cullen, about the year 1820, John Cameron, or Highland John, a carter in the royal burgh, was in want of a pair of cart trams or shafts. He applied to the forester to have his wants supplied, who, liking a timely joke, said, "John, there is a grand piece lying at the Chalmers Slacks, just the right length and proper bend, and every way suitable; besides, to oblige you, John, I will let you have it cheap." The piece was got home, and forthwith made into the cart shafts, and it does not appear whether the carter ever knew

of the intended joke or not, but the shafts wore out the cart, and the carter as well, and were still good many years after him. From that time henceforward many persons have made use of the larch for that and similar purposes, and at the present day it is almost as difficult to find the shafts of a cart made of any other wood than larch, as it was at that time to find them made of it.

Like everything else, if good, it is overlaid with praises and unduly extolled, and if bad, it is too severely condemned, and the good that is in it is either denied or neutralised.

Some accounts given of the larch make it appear that it will not burn, and that it will resist fire almost as completely as iron or brass. Some, again, have said that the larch burns stronger and brighter than any other wood, and that the army of Hannibal, on crossing the Alps, made use of it in first heating the rocks before pouring vinegar upon them to rend and disintegrate them. Some old accounts say that the larch, as furniture or as dressed wood, shines in the dark as if all in a blaze of fire, and so bright that people at a distance would say the place was in a state of conflagration. Others would persuade us that neither saw, axe, nor other edged tool would take effect upon it or cut it, and that great danger attended the application of the plane, chisel, or other sharp instrument, and that such instrument would fly to pieces on coming in contact with it, and do bodily harm to the operator.

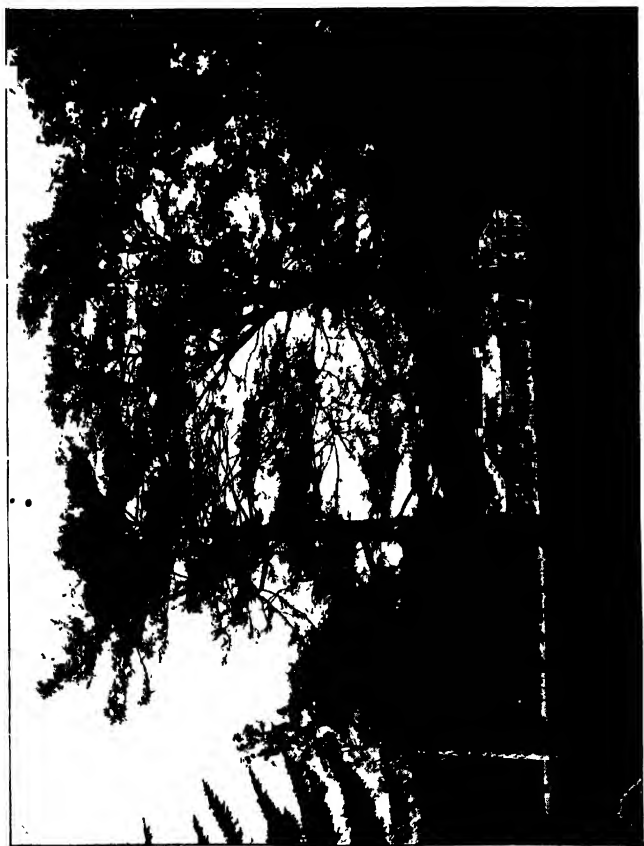
Some statements also would make us believe that the larch, if kept under sea-water for a great number of years, becomes as hard as iron, so that the tempered chisel would not cut it. And by some, and no doubt the more superstitious class, it was thought to be invested with the essential elements of evil, for if left in a certain place and position at night, it was removed and altered in shape and form by next morning. Some thought it partook of the nature and habits of the serpent, and this impression was confirmed by the extraordinary manner in which it in some cases warps and twists after being sawn.

CHAPTER XXII.

REMARKABLE TREES.

NOTHING connected with forestry so much delights the true admirer of forest grandeur and magnificence as beholding a grand old monarch that has weathered the storms of some hundred winters, and which audibly speaks in its own language when those who planted it lie in peaceful ashes beneath its spreading boughs.

The Dunkeld larches (see our illustration) are generally considered the oldest, noblest, and most interesting in Great Britain. The two oldest and largest, variously stated as planted in 1736 and 1738, according to different accounts, are growing in the old flower-garden (now pleasure-ground) near the venerable Cathedral, and though, from their extreme height, the top branches periodically show signs of decay, they yet again and again revive, and at the present day are so healthy and growing, that to all appearance they may outlive the youngest person. The largest in 1831 was estimated to contain 350 cubic feet of timber, and now it is estimated to contain altogether of measurable timber about 480 cubic feet, and the other tree about 50 feet less. In 1831 the largest one, at four feet from the



THE MOTHERS

ground, girthed 12 feet, and the other at the same height girthed 11 feet. In 1867, at the same height, I measured the largest tree, and found it girth 16 feet at three feet from the ground, and on measuring it the other day, I found the largest one $22\frac{1}{2}$ feet at one foot from the ground, $17\frac{1}{2}$ feet at two feet from the ground, and 16 feet 3 inches at three feet from the ground—extreme height, 100 feet. Girth of the other tree, $13\frac{1}{2}$ feet at five feet from the ground, and about the same height and equally healthy.

Mr. William Blackadder, surveyor, Glamis, Forfarshire, in 1831, says: "A few years ago, having been requested to measure one of the large larch trees at Dunkeld, the following amongst other observations were taken:—An observation was taken for the diameter at the mark level of the eye (being five feet above the ground) for the satisfaction of the party who was present, which was found to be $3^{\circ} 40'$, and made the circumference 12 feet 3 inches. It was tried by the tape line, and found to be $12\frac{1}{2}$ feet. At 18 inches above the ground the tree measured 16 feet round, but this was occasioned by inequalities, and the angle of $4^{\circ} 30'$ for the measurement at the base was taken a little above that point. As there was some measurable timber above the point assumed for the observation, although of a coarse description, this celebrated tree in round numbers may then have been said to contain 400 cubical feet by customary measurement. In spring 1831, when this measurement was made, the tree was ninety-five years old, having been planted

in 1736, and had on an average acquired $4\frac{1}{2}$ cubic feet of timber. There is another larch tree within a few feet of it of nearly the same dimensions." Besides the two parent larches thus described, there are others, though neither so old nor large, yet of great interest as splendid specimens of timber trees. On the south bank of the river, about a mile above the bridge, and within a few feet of the water's edge, stands as fine a timber tree as the eye could well look upon. It stands on low ground, which makes it look smaller and not so tall as it really is when close beside it. When I saw it fourteen years ago, it was estimated at 115 feet in height, 14 feet in girth four feet from the ground, 109 years old, and containing 230 cubic feet of timber. Though not of a fast-growing nature, yet it must now be considerably larger.

At New House park, that part of the grounds where the famous larches grew of which the *Athole* frigate was built in 1818, there stands to-day as fine a larch tree as can be seen in this or any other country, and is doubtless one of the same class and age of tree as those cut on that occasion. It is computed at 120 feet in height, perfectly straight, gently tapering, and symmetrical in every part. At a foot from the ground it girths 13 feet 10 inches, and at five feet from the ground 11 feet 2 inches, containing at least 300 cubic feet of as fine timber as ever grew.

Of the eleven larches at Blair, six only now remain. They are by no means either so large or so handsome as those at Dunkeld of the same age, but are equally

healthy, and, in the writer's opinion, will continue to grow when those at Dunkeld have ceased. In 1867 they girthed respectively, at three feet from the ground, 12 feet 9 inches; 11 feet 6½ inches; 10 feet 10 inches; 10 feet 8 inches; 10 feet; and 10 feet 8 inches. The average contents of the whole, about 180 cubic feet of measurable timber. One reason, and probably the principal one, why the larches at Blair are smaller and less handsome than those at Dunkeld, is in consequence of the severe exposure, having all several times lost their tops, and from time to time had large limbs ruthlessly broken off by storm and tempest. They are also much bent and crooked, showing unmistakable signs of adversity, contest, and struggle. There are many other trees about Blair in Athole and Dunkeld well worthy of description, whose ages vary from 120 to 130 years, and contain upwards of 200 cubic feet of the very best quality of timber.

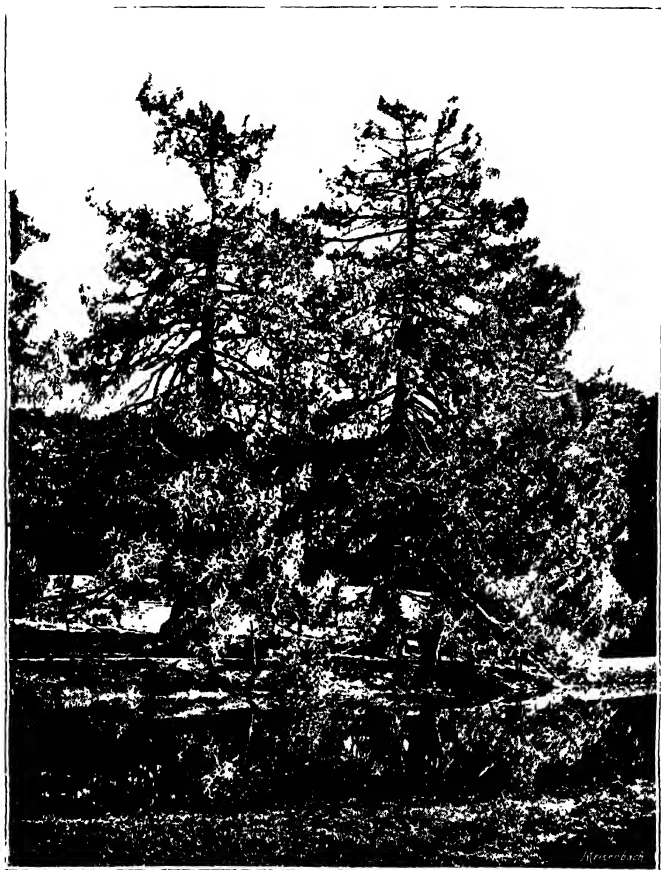
Two of the five larches planted at Monzie Castle in Perthshire have attained an immense size and perfection, as shown in the annexed illustration.

Mr. William Blackadder, writing in 1831, says: "Being near Crieff, I went to see the celebrated larches at Monzie, said to have been planted about the same time as those at Dunkeld. There are five of them growing near together in a shrubbery or old garden close by the mansion, three of which are noble trees. My time did not permit me to measure them accurately, but from some observations made with the sextant, they appear to range from 200 to 250 cubic feet,

and were 90 feet in height. The largest measured 21 feet in girth at the base, but this chiefly arises from inequalities and protruding portions of the roots. The tree tapered very quickly in the bole, and did not carry up timber like those at Dunkeld, but was more ornamental, being feathered with branches to the bottom."

The larches at Monzie Castle, though originally six in number, are now only four. They are said to have been planted in 1736 or 1738, and brought or sent by Mr. Menzies of Glenlyon, who brought the Dunkeld ones. One of them was cut down many years ago, but for what purpose is unknown, and a growing lime-tree was planted to mark the site. The stool or root part (about three feet) of the other one is fresh, and indicates having been a noble tree. It girths 15 feet 3 inches round above the swell of the roots, and 2 feet 9 inches diameter where cut off, exclusive of bark and sapwood, both of which are quite wasted away.

No. 1, the largest of the four, girths $26\frac{1}{2}$ feet above the surface of the ground, at three feet up 17 feet $6\frac{1}{2}$ inches in girth, and at five feet up 17 feet 1 inch. It stands 103 feet high, and contains about 380 cubic feet of timber, including bark. The tree is clothed with branches to near the ground, some of which are over 45 feet in length, twisted and curved fantastically, and are suspended on forked poles to keep them from injury. On the south side the branches hang over the carriage drive and dip in the waters of an ornamental lake. This is truly a magnificent tree, picturesque,



THE MONZIE LARCHES

REMARKABLE TREES.

bold, rugged, irregular, majestic, and grand. It is the pink flowering variety, the seeds quite sound and of vigorous growth, and this season has made wood freely.

No. 2, the second largest tree, girths 21 feet 4 inches at base, 12 feet 10½ inches above the swell of the roots, and 12 feet 6 inches at five feet up, and contains about 300 cubic feet. On the south side at the base there is a remarkable protuberance, the result of having stood in the fence where the garden existed. The timber is of better quality than No. 1, the branches being smaller. It is of the light-coloured flowering variety, bears sound seed, and is making wood rapidly.

No. 3 is next in size, measures 14 feet 10 inches at base, and 11 feet 6 inches above the swell of the roots. This is also a great tree and the wood of fair quality. It is of the light flowering variety, bears sound seed, and contains about 270 cubic feet of timber.

No. 4 is the smallest of the four; it girths 12 feet 5½ inches at base, and 9 feet 10½ inches at three feet above ground. It is about 100 feet high, and contains nearly 200 cubic feet of timber; and being somewhat deficient in branches, the timber consequently is of finer quality. It is of the dark-coloured flowering variety, bearing cones and seed of sound quality.

They are all between 93 and 103 feet in height, in excellent health, and making wood rapidly. They stand upon a dry soil, the ground gently sloping on what once was the side of a garden or shrubbery fence,

THE LARCH.

posed to the south and east, and sheltered from the north and west by rising ground and timber trees. Though now 143 years old or thereby, they show no signs of decay, and to all appearance may continue growing to 200 years or upwards.

Monymusk.—The Monymusk larches are of sufficient importance to merit a paragraph all their own. Two miles north-west of Monymusk, on the north bank of the river Don, lies Paradise, a most delightful spot. It lies on a plateau at the foot of a high hill which protects it from the west, and on the north and east is sheltered by the great mountain Benachie, $2\frac{1}{2}$ miles distant. It stretches along the bank of the river about 220 yards in length, and 75 yards or thereby in breadth. Several of the larch and other trees have been carefully and repeatedly measured, and have letters upon them which preserves their identity. Some of the letters are now, however, scarcely legible, while others are quite distinct, amongst which are those marked B, C, and E, and the better to show at a glance their dimensions and increase of growth, they are presented in the annexed tabular form.

The nine last trees in the table, though not so large as the preceding three, are yet truly noble specimens, and any one of them a subject worthy of admiration. An accurate measurement of the height of all the trees is at present impracticable, other trees intercepting the view with their spreading branches, but it may be accepted that their heights vary from 95 to 102 feet, and contents from 175 to 416 cubic feet. The grove

ONYMUSK LARCHES

[illegible]

consists of 27 larches in all, 12 Norway spruce, 1 silver fir, 1 Weymouth pine, 1 Scotch pine, and various minor growths. It may be noted that the three largest trees, B, C, E, are still as healthy and vigorous as the smaller ones, as their increase of growth and outward appearance indicates. Taking the girth at 20 feet from the ground, for example, B increased between 1841 and 1850, 7 inches in girth, and made 24 feet 10 inches 6" cubic contents of wood, and also between 1850 and 1881, 12 inches in girth, and 96 feet 10 inches 6" cube of wood. C increased in the same period of 10 years 8 inches in girth, and made 65 feet 7 inches 3" cube of timber, and between 1850 and 1881, 1 foot 5 inches in girth, and 147 feet 1 inch 4" cube of timber. E likewise increased in the same periods 5 inches, and made 41 feet 6' 8" cube of timber, and 12 inches of girth, and 84 feet 11 inches 8" cube of timber.

The tree marked C is decidedly the noblest and best grown of the group, and although it girths less at the base than some others, it yet carries its thickness to a greater height than any of them, and is, indeed, as near a perfect tree as can be seen in this or any other land, whether in point of value or nobleness of growth.

The whole scene of Paradise irresistibly recalls to mind the sublime theme of the immortal Milton, and inspires us with a glowing desire to see the once beautiful garden grounds of Paradise on the Don, now almost effaced, again restored to their pristine glory; and

this desire is all the more intensified by the fact that Her Majesty Queen Victoria honoured the place with a personal visit in October 1866, and the noble larches thus lay claim to the title of Royalty, to which they are at least as much entitled as any other trees in the Queen's dominions.

There is also one tree on the margin of the flower garden of Monymusk deserving special attention. It is of the same age as those at Dunkeld, Monzie Castle, and Glenlyon are said to be, and though inferior in size to any of them, is yet a fine specimen. It grew originally along with other two in flower-pots in the dining-room, there being probably no greenhouse at that time, and, as tradition says, the garden larch, as it is termed, grew in a pot till too high, when it was planted into the line of a beech hedge of the flower garden, where the soil is thin and poor, and considerably exposed. Under these disadvantages its side branches had been much confined by the hedge and other trees, which caused it to grow up comparatively tall and bare of branches. It is 70 feet high, 18 feet to the lower branches, girth at base 9 feet, and at 6 feet from the ground 7 feet 5 inches, and contains 120 cubic feet of evidently hard close-grained timber of fine quality. The tree, though now 143 years old, is still quite healthy and growing. The other two trees, its original companions, were blown down by a gale in 1829.

In Roxburghshire, at Weens, Wolflee, and Minto House, there are large and well-grown larches of excel-

lent quality of timber, but few of them, except those at Minto subsequently recorded, require more than a general notice.

Mr. Blackadder says: "I measured a large larch tree at the side of the Allan water at Kippenross garden, which was done with the sextant in a way similar to that detailed at Dunkeld and Monzie, and the contents were found to be 170 cubic feet. The tree is still in vigorous growth. I measured it in 1817 exactly in the same manner, and again in 1832; it was 15 feet higher, and had acquired about 50 cubical feet of timber."

The following trees are recorded in the Highland and Agricultural Society's "Transactions" for 1861:—

"A tree in the garden of Kinloch, of the same growth as those at Dunkeld and Blair in Athole, 85 feet high, and 14 feet 8 inches girth near the ground.

"At Kippenross garden there is a tree 108 feet high, and girths 18 feet at the ground; at $27\frac{1}{2}$ feet from the ground, where it divides into limbs, it girths $8\frac{1}{2}$ feet; at 54 feet from the ground it girths 7 feet; and contains, without the branches, 515 cubic feet of timber.

"At Dalwick, in Peeblesshire, there is a tree 90 feet high, girth near the ground, 14 feet. This is probably also one of the first that was planted in Scotland.

"At Newliston, in the parish of Kirkliston, there is a tree in a very healthy condition, which girths at the ground 22 feet 5 inches; at 3 feet from the ground, 13 feet 10 inches; at 6 feet from the ground, 12 feet 6 inches; age upwards of 110 years.

“At Hopetoun there is a tree 99 feet in height, girth 9 feet 9 inches, age from 100 to 150 years. It is in a fine healthy condition, and likely to live many years.

“At West Den of Gray, in the parish of Liff and Benvie, there is a tree 100 feet in height, and girths 15 feet at 1 foot from the ground.

“At Lathrick House there is a tree 42 feet in height, and at 1 foot from the ground girths $15\frac{1}{2}$ feet. The tree is in excellent health and vigorous condition.

“At Craigdarroch House, in the parish of Glencairn, there are said to be some notable trees over 140 years old, and though not tall, are of great girth and in good health.

“Also at Delhandy, in the parish of Strathdon, there are many splendid larches, but few of them of extra size. They are, however, well worth paying a visit to.

“At Pinmore, in the parish of Colmonell, there are two notable trees spoken of, over 140 years old, and girth nearly 12 feet at 3 feet from the ground.

“At Dumfries House, in the parish of Cumnock, one tree contains about 260 cubic feet, and is about 100 feet in height.

“At Kirkmichael, in the parish of same name, there is one tree which girths over $17\frac{1}{2}$ feet at 6 feet from the ground.

“At Glenrobuck, in the parish of Old Kirkpatrick, there is a tree reported as 143 feet in height, girth 13 feet, and age about 200 years.

“In the policies of Auchintorlie, in the parish of Old Kirkpatrick, there is a tree said to be 140 feet in

height, girth 10 feet, and 150 years old; the man who planted the tree died at 105 years of age”

At Forglen House, parish of Forglen, there are some excellent larches about 120 years old, which contain over 250 cubic feet. There is here also a very remarkable variety of the larch, with a tall stem, clustered branches, a great quantity of cones, and outline very picturesque. It is a very distinct variety, locally called the “American larch,” probably *Pinus microcarpa nana*.

At Darnaway, in Morayshire, there are some notable larches, some of which the Scottish Arboricultural excursion party, in August last, took notice of. Two trees, planted in 1790, are over 100 feet in height, one of them measures 8 feet 9½ inches at 1 foot from the ground, and 7 feet at 5 feet up, and contains 102 cubic feet of timber. The other girths 9 feet 9½ inches at 1 foot up, and 8 feet 6½ inches at 5 feet from the ground, with 190 cubic feet of timber.

At St. John's Mead there is also a magnificent larch, already historical; it is over 100 feet high, girths 12 feet 2 inches at 1 foot up, and 9 feet 4 inches 5 feet up, and contains 240 cubic feet of timber. Others also of large dimensions, and 120 feet in height, are here to be met with, all sound trees, healthy, and of excellent quality of timber.

At Altyre, in Morayshire, there is, besides the very extensive area of splendid larch and fir plantations, some notable larch trees, which, from the time I saw them, fourteen years ago, have made great progress in

growth. The following are the measurements of three of them taken the other day :—

No. 1, 108 feet high, splendid symmetrical trunk, 85 feet in height, girth 14 feet 5 inches at 1 foot from the ground, 12 feet 4 inches at 2 feet from the ground, and 11 feet 5 inches at 5 feet from the ground, containing nearly 200 cubic feet of timber.

No. 2 girths 9 feet 3 inches at 1 foot from the ground, 7 feet 9 inches at 5 feet from the ground, and contains 138 cubic feet of timber.

No. 3 girths 11 feet 6 inches at 1 foot from the ground, 8 feet 10 inches at 5 feet from the ground, with a trunk 75 feet in height, containing 140 cubic feet of timber.

At Ochertyre, in Perthshire, there are some splendid larches, some of which I measured at random the other day, and are not the largest on the estate. No. 1 girths 10 feet 8 inches above the swell of the roots, with a perfectly clean stem of 40 feet, as straight and smooth as a marble column, about 75 feet in height. No. 2 girths 10 feet 5 inches above the swell of the roots, and is also a splendidly grown timber tree; and from its healthy appearance, it, as well as many more growing on the sloping bank immediately behind the mansion, are certain in course of years of being magnificent trees, being all comparatively young. *

At Ardross, the seat of Alexander Matheson, Esq., in the parish of Rosskeen, are some excellent though not old larches; and on his property at Stornoway there are a few good and healthy trees over 100 years old.

At Castle Semple, in the parish of Lochwinnoch, there are some excellent trees, one of which measures 65 feet in height and 10 feet in girth, and contains over 200 feet of timber.

At Airdwell farm, in the parish of Kirkbean, there is at least one fine tree, very healthy and growing; it is only 82 years old, and yet contains 160 cubic feet of timber.

At Novar, in Ross-shire, there are some splendid trees; one in particular, growing on the south-west side of the garden, measures 96 feet in height, with a clean almost cylindrical stem of 36 feet. It is believed to be about 120 years old, and contains 210 cubic feet.

At Balnagowan, in Ross-shire, there are some very fine specimens of larch; not a few of them stand over 100 feet in height, and contain over 150 cubic feet of timber, quite sound and healthy, and well worth seeing.

At Tulloch Castle, in Ross-shire, there are the remains of what once constituted the finest larch and fir plantation in the North of Scotland. It was planted in 1768, and comprehended 1000 acres imperial. On the extreme top of the hill of Tulloch, although high and much exposed, there is a tree still standing containing over 50 cubic feet.

Brahan Castle was at a former period unsurpassed for its larch. Mr. Grigor gives the following account of it in his book on Arboriculture, at page 220:—
“ One of the finest clumps of larch ever produced in

Scotland was grown at Brahan Castle, on the banks of the Cannon, Ross-shire. It originally occupied about one imperial acre. When I last saw it, the remaining trees were about eighty years of age, and averaged about 90 feet in height. The trees stood about 20 feet apart, and many of them contain 100 cubical feet."

At Cannon, in the parish of Urquhart, on the south side of the river, there are many very fine larches. Some which I measured a year ago girthed as follows:—One of them 7 feet 1 inch at 3 feet from the ground, another 7 feet 10 inches at the same height, and another 8 feet. They are young, well grown, and all splendid timber trees for commercial or industrial purposes.

At Belladrum, in Inverness-shire, there are several fine trees; two I measured last October girthed respectively 15 feet above the swell of the roots, and 11 feet 5 inches about 3 feet above ground. They are both in excellent health, and likely to survive to a great age.

Several fine larches are growing in a glen at Cullen House, Banffshire, planted about 1767. They contain from 100 to 160 cubic feet of timber, are in excellent health, and now increasing at the rate of from 2 to 4 cubic feet annually. They are inland from the Moray Firth from one to three miles, and are sheltered from the sea and other exposures by rising grounds. The soil is a light, dry, gravelly loam, resting in some places upon clay, and in others upon sandy gravel and water-worn stones. The trees are well clothed with branches, having always had ample room.

On the Strathmore estate, Forfarshire, hundreds of acres of larch, from 90 to 110 years old, have been cut down, and also on the neighbouring estate of Lindertis, belonging to Sir Thomas Munro, Bart., where trees similar to those about to be described are still to be found. These are the only estates in the county where a great number of old larch was grown, but that is now almost a thing of the past.

The following eight trees are growing in a mixed plantation of 56 acres, within the policy grounds of Glamis Castle, and measure as follows:—

No	Girth at 5 Feet from the Ground		Height of Tree.	Age.	Cubical Contents.
	Ft.	In.	Feet.	Years.	
1	11	7	85	110	250
2	10	5	90	110	250
3	10	"	105	110	222
4	10	"	98	110	229
5	9	2	106	110	200
6	8	6	110	110	213
7	8	9	94	110	190
8	8	6	95	110	175

With the gale of 28th December 1879 one tree at the same place and same age as the above was blown down, which girthed at 5 feet from the ground 12 feet 6 inches, height 107 feet, and contained 320 cubic feet of timber. After the root was cut off, by request a slice was cut from it and sent to Sir Robert Christison for the museum of the Botanic Gardens, Edinburgh. Sir Robert's remarks were, that had the tree been allowed to grow to the same age and at the same

rate as hitherto, it would have far surpassed in size the famed old Dunkeld larches.

Mr. J. Stewart, Inveraray, says the following ten trees are growing on the estate of Inveraray, and measure as follows:—

No.	Girth at 5 Feet from the Ground.		Height.	Altitude.	Cubical Contents.	Aspect.
	Ft.	In.	Feet.	Feet.	Feet.	
1	10	9	120	500	220	S. East
2	10	9	90	300	200	N. East
3	10	4	110	100	200	N. East
4	10	3	110	100	200	N. East
5	10	1	120	500	200	S. East
6	10	2	110	60	190	S. East
7	9	10	110	60	180	S. East
8	9	6	110	60	180	S. East
9	9	4	100	100	180	N. East
10	9	5	100	100	180	N. East

During the greater part of last century Drumlanrig Castle was surrounded by trees of great age which attracted public attention, but unfortunately they were all cut by the late Duke of Queensberry, and therefore when the property became the possession of the Buccleuch family in 1810, the estate was denuded of all its old and beautiful trees, except a few in the gardens and policy, which consist of beech, lime, chestnut, elm, and a few oaks.

Mr. Robert M'Cutcheon, Whittinghame, says: "I cannot say we have any specially notable trees here; our largest ones are from 65 to 70 feet high, and girth at 5 feet from the ground from 7 to 9 feet. They are, however, quite sound, and of fine quality."

Mr. Robert Leishman, Ravensglass, says: "There is only one larch tree on the estate of Ravensglass worth special notice, growing close by the carriage road. In the year 1870 I girthed it, and found it exactly 8 feet in circumference at 4 feet from the ground, and it now measures at the same height 9 feet. At 18 feet from the ground it girths 7 feet 6 inches, and contains altogether about 170 cubic feet of timber. It is from 80 to 85 feet in height, and was planted between 1790 and 1793. There are several others in the grounds of the same age, equally healthy, but none of them so large or well grown. There is one very fine larch tree growing on the estate of Arniston, which is said to be the second largest in Scotland, and also that the proprietor was offered £26 for it by a ship-builder in Leith more than forty years ago."

MEASUREMENT OF TREES GROWING ON THE ESTATE OF
ARDKINGLAS.

Age.	Height.	Girth at 5 Feet from the Ground.	Cubical Contents	Altitude	Exposure.	Aspect	Estate.	County.	Remarks.
3	5 ft.	2½ in.	..	40	N.	Sheltered	Ardkinglas	Argyle	When planted out 2 yrs. seedlings and 2 yrs. in the nursery lines.
14	30	18 in.	..	60	N.W.	Moderately	..	..
54	90	4½ to 6 ft.	58	30	N.W.	Sheltered	..	..
52	80	5 to 6 ft.	50 to 60	20	N.W.	do.	..	..
127	94	9 ft. 11 in.	150	50	N.	..	..	..

Mr. J. Robertson, Minto House, Roxburghshire, says:
"We have some splendid larches on this estate, and

the oldest, I am told, in Scotland, except those at Dunkeld, of which the following are examples :—

No.	Height.	Girth at 5 Feet from the Ground.		Exposure.
	Feet	Ft.	In.	
1	75	9	4	S. East
2	72	11	"	S. East
3	80	9	6	S. East
4	105	7	10	S. East

At Abercairney, in Perthshire, there are several old and very fine larches ; two in particular in the policies deserve special notice. The largest of the two is indeed a splendid tree ; it is 80 feet in height, and at 3 feet from the ground girths 13 feet 6 inches, and at 5 feet it girths 11 feet 9 inches. By a measurement of Mr. Murray in 1860, it girthed 11 feet 5 inches at 3 feet from the ground, and in 1876 12 feet 8 inches at the same height. There has thus been an increase in the girth of 2 feet 1 inch during twenty years, and 10 inches within the preceding five years. The smaller tree of the two girths 11 feet 10 inches at 1 foot from the ground, and 9 feet 11 inches at 5 feet, and gives a corresponding increase upon former measurements. They comprehend respectively 170 and 130 cubic feet of timber. They are both of vigorous growth, and manifest no signs of decay or disease, and though their age is not correctly known, they are believed to have been planted towards the end of last century.

Mr. J. Forgan, overseer, says: "At Bonskeid, in Perth-

shire, there are some excellent larches of various descriptions, but one in particular (shown in *frontispiece*), planted by Dr. Stewart upwards of 100 years ago, deserves special notice. It was planted along with three others, but all except itself have been cut down. This, though by no means the largest, is certainly one of the handsomest and most symmetrical trees to be found anywhere, as all admit who have seen it. At 1 foot from the ground it girths 12 feet, at 4 feet it girths 9 feet, and at 12 feet from the ground 8 feet 9 inches; it is 97 feet in height, and contains 189 cubic feet of timber. Several other larches on the estate are considerably over 100 feet in height, and perfect as timber trees, but cannot be compared with it in form and symmetry. A tree at Glenlyon, 9 miles from Aberfeldy, was said to be one of the first planted in Scotland, but now that it has been cut, and the years' growths counted, it is found that the tree had been planted about 1760, and not 1738, as generally alleged. The reason for cutting it was in consequence of its having died suddenly and unaccountably two years ago, probably a result of the unfavourable season of 1879. The wood of the tree, when cut down, was found to be perfectly sound in every respect, with the exception, as may be supposed, of the liber and the few layers of sapwood. At 7 feet from the ground it girthed 12 feet, and at 14 feet nearly the same; it measured 90 feet in length, and the trunk alone contained 315 cubic feet of timber, and the limbs, some of which were large enough to make railway sleepers, contained an additional 40 cubic feet.

It is of further interest to note respecting the growth of the tree: measuring from the pith or centre towards the circumference on one side, it was 2 feet 1 inch, and comprehended 120 rings or growths, forty of which nearest the centre varied from 1 inch to $\frac{3}{8}$ ths of an inch thick, and the other eighty growths from $\frac{1}{4}$ th to $\frac{1}{16}$ th of an inch. The other side measured from the centre 2 feet 11 inches, and of course comprehended the same number of rings, but of different thicknesses, the inner eighty of which varied from 1 inch to $\frac{1}{2}$ an inch, and the other forty outer ones from $\frac{1}{2}$ to $\frac{1}{4}$ of an inch, and the bark was about equal on all sides, namely, about 2 inches thick. The price obtained for the tree was only 10d. per cubic foot, which is fully accounted for from the difficulty of removing and nine miles of cartage. There are two larch trees of considerable note growing on the historical battlefield of Killiecrankie, near the spot, and probably designed to mark the place, where Dundee fell. They are not so large or so well grown as others that have been or might be mentioned, but are yet of sufficient interest to merit attention, both on their own account, and specially that of the place where they are growing. One of them at 4 feet from the ground girths 10 feet, and the other 10 feet 2 inches. They vary in height from 105 to 115 feet, and contain an average of 250 cubic feet of timber; they have evidently attained something near maturity, and already begin to show some signs of decay in the branches."

At Taymouth Castle there are several very superior

and handsome trees, some of which on the memorable night of the Tay Bridge disaster (28th December 1879) were unfortunately blown down, and were found to measure from 100 to 120 feet in length, perfectly sound, clean, and well grown.

To these as many more might be added, and yet not exhaust the list of remarkable larches throughout the country, but it is thought sufficient have already been mentioned to show the various stages of perfection at which the tree has arrived or may yet attain in this country; and in order not to unduly extend the subject, the annexed table, an abstract of the old and remarkable larch trees of Scotland, published in the "Transactions" of the Highland and Agricultural Society, is adduced, with the view of supplementing what may further be required under this head.

TABULAR ABSTRACT FROM THE "TRANSACTIONS" OF THE HIGHLAND AND AGRICULTURAL SOCIETY FOR 1861.

Counties.	No.	Height.	Girth	Age.	Altitude.	Soil.	Exposure.
		Feet.	Ft. In.	Years.	Feet.		
Aberdeen	1	90 to 100	10 2	117	1110	Loamy gravel	N & S.
		90 to 100	9 1	117	1110	Do.	N. & S.
		90 to 100	8 0	117	1110	Do.	N. & S.
	2	70 to 80	8 to 9	130	350	{ Black mould and moss }	..
	3	100	6 9	139	380	Sandy loam	North
	4	88	7 8	120 to 130	950 to 1000	Hazel loam	..
Argyll	5	82	7 9	114	980	Loamy	..
	6	70	7 0	60	170	Sandy	South
	7	130	10 0	100	..	Brown loam	E. & S.E.
	8	80	8 1	..	..	..	..
Ayr	9	90	9 1	130	180	Sandy loam	North
		82	11 3	130	180	Do.	North
	10	93	10 8	..	..	Light red loam	North
Banff	11	65	17 6	..	..	Moss	..
	12	90	16 0	109	160	Vegetable loam	East
Dum- barton	13	143	13 0	150 to 200	60	Loamy	South
	14	140	10 0	140	140	..	South
	15	86	12 0	90	240	Light sandy	North

TABULAR ABSTRACT—Continued.

Counties.	No.	Height.	Girth.	Age.	Altitude.	Soil.	Exposure.
		Feet.	Ft. In.	Years.	Feet.		
Dumfries	16	..	13 7	130	..	{ Shallow light mould }	E & W.
	17	..	14 7	130	..	Do.	E. & W.
	18	..	7 0	100	..	Clay loam	..
	19	45 to 50	6 to 7	..	..	..	..
Edinburgh	20	90	11 6	136	..	..	..
	21	80	8 6	80	300	Loamy	North
Elgin	22	105	12 7	150	180	Moss	South
	23	..	12 0	..	..	..	..
Fife	24	42	15 6	..	..	Light	South
	25	80	7 6	..	300	Light sandy	South
Forfar	26	102	8 4	100	300	Sandy loam	S.E.
	27	100	15 0	..	..	..	..
	28	100	12 0	..	..	..	..
Kirkcudbright	28	80	..	76	..	..	S.E.
Lanark	29	64	6 11	..	800	Clay	S.W.
	30	92	8 0	..	600	Light	S.E.
Linlithgow	31	99	9 9	100 to 150	100	Loam	North
	32	..	22 5	100	..	Loam	..
Fife	33	90	14 0	..	650	Light loam	North
	34	..	10 0	..	..	Alluvial	South
Perth	35	..	8 0	..	..	Do.	South
	36	90	8 0	80	400	Rich loam	East
Perth	37	108	18 0	120	150	Sandy	N. & E.
	38	98	15 5	120	..	Light alluvial	..
Perth	39	56	11 6	130	250	Loamy	South
	40	..	7 to 14	..	350 to 700	..	..
Perth	41	100	10 6	124	..	Sandy loam	..
	42	80	13 11	..	..	Light loam	..
Perth	43	45	9 0	..	..	Black loam	..
	44	85	14 8	..	..	Deep loam	..
Perth	45	90	15 0	140	200 to 300	Light gravelly	South
	46	..	8 2	110	240	Earth	South
Perth	47	..	10 0	90	..	Sandy loam	..
	48	63	10 0	..	..	..	..
Renfrew	46	63	10 0	..	..	..	..
Ross	47	..	..	100	50 to 100	Moss	S.E.
Roxburgh	48	..	8 0	..	100	Stiff red clay	S.E.

CHAPTER XXIII.

DISEASES

ON examining the bark of the one year's shoots of the larch, it is found they are completely covered or coated over with epidermis, as close and perfect, indeed, as if painted, varnished, or enamelled. The young larch bark is the just admiration of every one, on account of its beautiful shining yellowish straw colour, which on close examination is found to be thoroughly protected from wet and every inclemency of the weather, and it seldom, or never happens that the young shoots after being ripened sustain any injury either from rain, cold, or frost. When, however, the succeeding year's growth begins, the bark of the former year's growth rapidly expands, and breaks open the beautiful epidermis or enamel, leaving the bark at the end of the second season's growth usually only about half covered with the enamel. It is the rupturing and destruction of the epidermis that is the primary cause of the ulcer or blister in the larch, of which we unhappily see and hear so much. I have said the primary cause, but it is not the only or whole cause. The wood and bark of the larch have scarcely any other protection in their

young state than the epidermis, and from the time it ceases to cover and protect the young shoot, till such time as the parenchyma becomes corky and strong, the tree is exceedingly liable to injury from frost, cold, wet and dull weather. The manner in which frost acts most injuriously upon the young larch, besides scorching the foliage, is by rupturing the globules of the sap-vessels of the bark, which are fully surcharged with a transparent greenish fluid, and when acted upon by frost, cold, or wet, is changed into red or brown, when it may be said the disease in question has commenced. On carefully examining the liber of diseased trees with the aid of the microscope, it is observable how many of the cells are injured. The fluid in the healthy cells, as already said, is of a transparent blue-green colour, and in those affected or diseased, it is changed to a red or reddish brown. The fluid when once changed never regains its natural colour, and the diseased or injured part never undergoes a complete healing. After the parenchyma is fully formed and become corky, there is little or no fear of the ulcer taking place. The cortical bark entirely defends the tree against any injury after it is fully formed, and I never saw a tree seriously affected with blister after the bark had become corky. If, therefore, warm and congenial seasons prevail till the trees are about twenty years old, they are then secure against being killed—at least if well clothed with branches to near the ground. The forester is glad when he sees the furrows and cortications of the bark well developed, as then he knows the danger to the tree

from blister, at least in that part of the stem, is past. It is remarked that trees in their young state are much more tender than they are when old and the bark has become corky. We have only to look at the branch of an old or advanced tree and examine its bark, to see wherein the difference of results arises. The cuticle of the shoots of the young tree almost entirely disappears after the third year's growth, whereas on the branches of old or middle-aged trees it is comparatively whole at five, six, or seven years; and while the cuticle is comparatively whole, the parenchyma is increasing at a rate far beyond that at which it grows on the stem of the young tree. The parenchyma is thus as thick and corky on the branch at three years old as it is upon the stem or branch of the young tree at six or seven years. This, I think, sufficiently explains the difference of hardness between young trees and that of older ones. I am not aware of ever having seen one year's shoots, whether vertical or horizontal, injured by frost after the wood had been fairly matured and ripened. As the spring however advances, and the force of the sap expands the liber, the epidermis of the young shoots is ruptured and opened, leaving the thin and tender green bark entirely exposed to the elements, whether frost, rain, or cold. It is therefore between the periods of the expanding or breaking of the epidermis and that of the forming of the parenchyma, or corky part of the bark, that the greatest danger to young larch plantations takes place. The much-deplored blister rarely if ever occurs

either upon the one-year shoot or upon the stem, after the parenchyma or cork bark is fully formed. The blister is not confined to any one particular part of the tree, but is found sometimes only a few inches above ground, and at other times near the top, and alike upon the stem as upon the branches, but, as already stated, probably never on the one-year shoot, which is completely protected by the epidermis. The whole bark of the young larch tree, like the skin of the little child, is extremely tender and susceptible of injury either from cold, wet, frost, or dull weather. The bark of the young tree bears the same comparison to that of the old, as the skin of the child's hand does to that of the blacksmith's; and the analogy extends further than may at first appear, for as the parenchyma and epidermis are considered the excretions of the alburnum or sapwood, so the horny skin of the hand is the secretion of the blood. The hard hand is ~~no~~ less serviceable to the man who handles rough and heavy tools than the corky bark is to the tree in protecting it from a hundred evils.

The bark of exogenous trees and shrubs in this country consists of three distinct parts:—1st, the liber, inner bark (endophloeum); 2nd, the parenchyma, middle layer of bark (mesophloeum); 3rd, the epidermis, outer bark (epiphloeum). The bark undergoes wonderful changes in different species of trees, and even in the same species at different stages of growth, and in the latter respect none more so than the larch, for in the young shoot it is one thing,

in the middle-aged tree another, and in the old tree another.

The dry, callous, inert matter, apparently of no great use, serves the very important purpose of protecting both the liber or inner bark, and the cambium or new-formed wood underneath, from the vicissitudes of the weather. The bark appears to affect in a wonderful manner the exhalation, inhalation, and elaboration of the sap with the gases, which in other and even the same plants at an earlier period are affected through their leaves. A wound through the cortical layers of a young plant heals without a scar, but a wound through those of an old one is never healed.

The larch, like any other tree, is liable to accidents and diseases of various kinds, and to certain accidents and diseases from which other species are exempt. Some of the most common and serious diseases to which the larch is liable are *ulcer*, *blister*, or *bleeding from wounds*, which occur in the stem and bark; *ground-rot*, *heart-rot*, which commence in the central part of the root and ascend into the stem or trunk of the tree; and *disease of the foliage*.

The **ULCEROUS DISEASE**, which occurs in the bark of the stem, manifests itself at every stage of growth, till the trees are of considerable size and age, and the bark well corticated; sometimes it occurs in the nursery lines and sometimes on plants only a few years in the forest. It makes its appearance first upon the tender bark of the tree, and is evidently the result of several causes, such as confinement, superabundance of moisture, cold, wet

seasons, spring frosts, &c., and indeed any influence that injures the outer coating of the bark. It is most inveterate on wet, cold soils, such as the borderlands of Scotland and the North of England, and all wet, cold, and clayey soils, damp situations, and imperfectly drained ground. The preventive means are early and free thinning, cutting down and removing all luxuriant herbage that intercepts the air, more thorough drainage, and strict attention to preserve all the lower side branches vital till the bark is corticated, heart-wood formed, and the roots sufficiently spread to act as food-collectors as well as water-conductors in conjunction with the branches and atmosphere.

The second form of disease (GROUND-ROT) commences usually deep in the soil, in the roots which first and farthest enter the subsoil. The decay when once commenced ascends in the cellular longitudinal tissues of the wood, in various forms and different degrees, according to aggravating circumstances. When the trees are cut down, the disease is shown in its various stages of advancement,—sometimes the wood only slightly discoloured, in others soft and spongy, and again in others in soft rotten pieces, resembling partially decomposed sawdust. The causes of this form of disease are various such as water in the subsoil, stimulated early growth by manures, &c.

Preventive means.—Drainage, avoiding all kinds of manure, keeping the roots near the surface in planting, and abundance of room to promote spread of roots and branches.

The third form of disease is TRUNK-ROT, sometimes termed dry-rot. It differs from ground-rot in two particulars—first, in the producing cause; and second, in the various forms the disease assumes. Dry-rot is consequent on the tree having exhausted all available food within reach, and being constitutionally too weak to search for more.

Preventive means.—Planting only such soils with larch as are known to contain the proper elements of food, and sufficient room to spread its roots and branches on all sides, removing the surface turf and soil, especially if rich and damp.

The signs of this disease are unusual quantities of fruit, smallness of growths, both in the leaders and side branches. The soils which most conduce to this disease are sandy and light, with an unfavourable difference between the condition of the active soil and subsoil. The ground having been under cultivation and manured previous to planting, and the manure so far still present in the soil as to promote a growth in the trees which cannot be longer sustained, consequently leaves the tree in a hopelessly exhausted condition.

A fourth form of larch disease is another phase of trunk-rot, in the Highlands of Scotland termed ROY. It differs essentially from the two preceding forms of trunk-rot. It is generally known as matter of fact that the volatile substances of resinous trees undergo various chemical changes during the growth of the tree and maturing of its wood.

The mealy or white American bug, *Coccus laricis*, is an insect commonly found on unhealthy larches at the various stages of growth, chiefly in sheltered situations and upon damp soils, in excessive wet, cold, or dry seasons, after frost or scorching suns. I do not consider the effects of this insect fatal to the tree generally, as it neither eats the leaves nor breaks the rind, but its presence is always an indication of an unhealthy state, and by remaining long upon the tree may aggravate or even lay the foundation of permanent disease. Trees in their younger stages of growth are much more liable to attacks of the *Coccus laricis* than advanced and old trees, and this goes far to establish the opinion that free exposure is essential to the healthy growth of the tree.

That much good can be done to sickly or diseased larch plantations under certain conditions, I am quite certain of; for example, thinning, or cutting down undergrowth or rank herbage which is preventing the air from circulating through the plantation, paring off the matted grassy turf, or turning it upside down, and draining so as to carry off stagnant water, &c.

Cold hard winds and excessive sea exposure do not suit the larch, hence the margins of plantations specially so exposed should be bordered with a row of sycamore, mountain ash, or silver fir.

The larch may well be regarded as both a very tender and yet a very hardy forest tree. It is exceedingly tender and sensitive of frost when in leaf, and even before the leaf breaks, and when perhaps 6° of

frost occur; at that stage it may prove fatal to it. On the 24th, 25th, and 26th days of December 1860, when most forest trees suffered, and millions were killed, the larch suffered nothing; and that is believed to be as thorough a test as any that could be adduced on the subject, for the frost then was more intense than it ever was known in the memory of the oldest living person. Mr. E. J. Lowe, writing to the "Times" from his observatory at Beeston, near Nottingham, says: "This morning the temperature at four feet above the ground was 8° below zero, and on the grass 13.8° below zero, or 45.8° of frost." In the year 1234 a whole pine forest was killed at Ravenna in Italy, but it is thought no larches were in it. A young larch plantation, eight years old, situated in a glen upon the Marquis of Lothian's estate near Jedburgh, suffered much from a frost which occurred in April 1859. The trees in the bottom of the glen, which was rather wet, were nearly all killed, and those which escaped were all less or more injured, while those on the tops of the banks on either side, at about 60 to 80 feet higher altitude, escaped without harm. Experience has proved that it is much safer to plant Norway spruce or *Abies Douglasii* in damp, low-lying districts liable to late spring frosts, than larch. In the summer of 1868 a severe easterly wind prevailed in the North of Scotland between the 15th and 20th of May, which left the larch, where exposed to the north-east or east, quite red, and in some cases the trees upon the margins of the plantations had their branches and tops killed,

leaving it doubtful whether or not they would ever recover. All along the coasts of the shires of Banff, Moray, and Aberdeen the larch was twice during that season, in exposed places, quite defoliated. This was not the effect altogether of the sea air, as larches ten miles inland had also suffered, though not to such a degree.

It is maintained by some that nearly all the diseases of larch are engendered in the nursery, either by crowding the plants in the nursery beds or stimulating their early growth by strong manures. All nursery-grown plants, however, are by no means crowded, neither are they all forced by manure, although the first planted larches in this country, being grown in the London nurseries, were probably so treated. In selecting the plants for small plantations, choice is generally made of trees which have stood open and clear of each other in the nursery; but it has been often shown that the best-grown specimens fall a prey to disease as well as those less favoured; and even self-sown plants, though standing as single specimens, and grown free from all artificial manures, fall a prey to disease along with those otherwise raised and planted amongst them.

The result of sowing diseased seed appears to me either to be no plant produced at all, or a small and weakly one. In the latter case, time and attention may restore it to strength and vigour, which, if once attained by natural and proper means, there appears no good reason why it should afterwards relapse into a state of degeneracy and disease.

If the theory of hereditary disease be correct, a crop would occupy the ground as various as were the diseases of the seeds—one tree affected with dry-rot, another with blister, another with *Coccus laricis*, and in the centre of a group which had died off suddenly one or two in perfect health. The reverse of all this is the case. However mixed the trees are when planted, subtle disease attacks them all alike or in groups.

Many hold the opinion that sound trees can only be grown from imported seed, and contend that the action of the pollen in local plantations is such as to corrupt the seed; that the pollen of diseased trees is conveyed to those that are sound, and thereby contaminate the seed. They, too, point to the first introduced larches—at least as good as any yet grown—in support of their views. It is, however, an undeniable fact that thousands of trees grown from foreign seed become diseased, and many of the Duke of Athole's first planted larches were affected with blight and other diseases.

Deep planting is also looked upon by many as the cause of disease, and they point out trees where the roots are near the surface as the soundest and most healthy, while others whose roots are deeper in the ground are affected with ground-rot. The benefit of shallow over deep planting is doubtless twofold: *first*, the roots are larger and of better quality when near the surface, being better carbonised, and *second*, the admission of air and light to that part termed the neck

of the plant, thereby exciting it to grow in a way superior to others not so exposed. Deep planting upon a slope is not so injurious to the trees as it is upon flat ground.

The way in which deep planting proves most injurious to the trees is probably by placing their roots at a depth beyond the immediate action of the solar rays. I made some experiments with larch (three years transplanted) in a nursery. In planting, I put each alternate row two inches deeper than the other row, and found as the result that 30 per cent. of the deep-planted trees died, while the others all lived.

It is a settled question with many people that freely circulated water in some way applied to larch is all that is needed; but when asked in what way it should be applied, the answer is never forthcoming. It seems well to endeavour to correct this misapprehension, for although water may be near well-grown trees, it is not from the water or from wet soil that the tree derives its nourishment. It is nourished and sustained, not by the water, but in spite of it.

Drainage also has its strong advocates, who think and act as if open drains would make the larch grow. Wet ground is drained and planted; the trees flourish for a while, are seen to be flourishing, and so inspire confidence; the result is imparted to others, and thus the impression is spread abroad. On clay-drained ground the larch, after flourishing for a period of about fifteen years, dies suddenly, and all about the drains is forgotten. Or some one thinks the two-foot drain not

deep enough, and ascribes to that circumstance the cause of failure, recommending a two-and-a-half or three-feet open drain instead.

On looking at a drained plantation, it must be obvious to the least observant how well the trees grow along the margins of the drains, being often, at ten years old, 15 feet high, while the general plantation is only 7 or 8 feet high. The superiority of growth is at once attributed to the drainage, which leads to erroneous conclusions throughout of its being almost entirely due to another cause, explained thus: The earth excavated from the drains is sometimes thrown equally upon both sides—sometimes one side, and sometimes the other, as it happens to answer the hand of the workman—and it is *upon the excavated earth* that the plants so well flourish. It is to the loose open soil, and not to the drainage proper, that superior growth is to be ascribed. Drainage, unless upon moss, can benefit the growth of larch very little, because wet clays and such soils as truly require draining *are* not, even though dry, suitable for larch, hence they should be planted with other trees. Some maintain that dry soils are as injurious to larch as wet ones. This is not borne out in my experience. It is true larches die on dry soils, but it is not *simply* on account of the soils being dry that they die, but because of some deleterious or obstructive substance being in the way of the roots. Either the subsoil is pan, or the soil may have been exhausted by preceding crops of similar or different kinds, or poisoned by manure.

Wet clay soils are admitted to be fatal to larch, and yet upon such soils larch is not only planted, but promises to do well for a time, and then speedily dies off.

Larch is not exempted from the general natural law to which every other species of tree is subject—that certain limited conditions of soil and situation are requisite for the perfect development of its parts, and for the healthy and vigorous progress of its growth to maturity; yet it far excels most other trees in the wide range of these conditions, and sometimes develops and grows with equal fulness and force in soils and situations of almost opposite character. It seems, on the whole, to prefer alluvial earths, or deep, rich, gravelly lands; yet it grows well in almost every description of very poor soil, and may sometimes be seen vigorous and luxuriant on a shallow moor, or even on the naked rock.

An interesting article, comprehending a correspondence between the Duke of Portland and G. I. T., will be found in vol. xxii, 1833, of the Highland and Agricultural Society's "Transactions," which I give *in extenso*, being much to the point:—"It has been found in many soils, both *wet* and *dry*—to the latter I speak most particularly—that the larch, when between thirty and forty years old, decays in the heart. My plantations, and those of my father, have hardly suffered at all yet, while others in my neighbourhood have suffered so much as to be ruined by the distemper. When I use this word, I must guard against your supposing it

to be the effect of that disease *like mildew*, to which the larches, since 1802, have been subject; for though that disease sometimes, and indeed often, kills them in *low, damp situations*, yet, generally speaking, I know of no instances sufficiently numerous to warrant me in supposing that it has produced the effect which is the subject of this letter. Where, therefore, the soil and climate suit the larch, *there cannot be a greater national benefit than there to plant it.*

“In our endeavours to detect the source of a disease which appears to attack forests and individual trees, under the most various and indeed opposite circumstances, we ought, I think, to turn our attention to what may be considered the proximate and remote cause of the malady. The proximate cause is to be sought in the physiological structure of the tree; the remote cause must be traced to the soil. In my first letter to the Duke of Portland, I slightly adverted to both these causes; and I shall now cursorily retrace what I then observed.

“In trees properly so called—that is, in plants with woody stems—there is an annual formation of two concentric layers; the one being a layer of new wood called the *alburnum*, the other a layer of new bark, called the *liber*. The previously formed layers of the wood are confined *within*, and covered by, the new woody formation; and, on the other hand, the new bark is covered by the old. Thus the two annually produced sappy layers, are always in juxtaposition, while the old layers are carried farther and farther in

opposite directions from each other, attaining firmness of texture as they increase in age. These are to be observed as *general* physiological facts, though there may be particular instances which are exceptions to them. The inner layers of woody matter, acquiring firmness of texture as they recede from the more recent and juicy layers, become at length the heart-wood of the tree. In this view of the vegetable progress, it is of the utmost importance to inquire into the causes which induce that change of texture which has just been described, for if these can be traced with something like accuracy, a double advantage will be gained; for not only will the vegetable structure itself be better understood, but a remedy may be found for diseases which, in more instances than the one under inquiry, cause the destruction of the heart-wood. *

“But what are the vessels and organs of supply and elaboration? For the solution of this inquiry, I refer to the luminous theory of Mr. Knight. The scientific world has long been in possession of his theory. I may, however, be doing the cause of science some service by quoting passages of his own letters to me. In the one received in answer to my last communication upon the larch, he observes:—‘My opinion respecting the motions of the sap in trees is, that it is absorbed by the bark of the roots, carried up through the sapwood then transferred to the leaf, in which it becomes what is called the true sap or blood of the plant, corresponding with the arterial blood of animals; that this fluid descends by the bark, by which, or rather by its

glandular lining, the matter of alburnum is deposited ; and that which is not thus expended sinks into the alburnum or sapwood, and there in part joins the alburnus current. I say in part, because a part is expended in giving additional solidity to the sapwood of former years, and in converting part of that into heart-wood, and in giving increased solidity to the heart-wood previously formed. *So long as the heart-wood continues to receive new matter, I conceive it to live, and no longer.*' In a former communication, Mr. Knight had distinctly stated what the vessels were which, in his opinion, conducted this elaborated sap into and through the alburnum and inner concentric layers. He observed, 'that the unemployed portion of sap sinks into the alburnum through the misnamed medullary processes.' These processes, which have also been termed the *divergent* rays, appear to originate in the liber, and to converge towards the medulla or pith, but do not enter into it, nor certainly proceed from it. I had long ago conjectured and said that I considered the office of these rays or processes to be that of conveying *laterally* the prepared juices which were intended to support the previously formed layers of wood ; and in my letter to the Duke of Portland I stated that the *disease* of the larch might arise from some cause which prevented the elaborated resinous juices of the leaves and bark from passing in sufficient quantity, by the medullary or convergent processes, *from the alburnum laterally* into the inner layers of the wood. Now, if this view of the internal cause of disease be correct,

to what agent or original cause shall we ascribe that paralysis, or want of due conducting power in the vessels of supply? Are we to attribute it to some natural debility in the constitution of the tree, or to some external exciting stimulant, producing morbid action in the secreting vessels at a certain period of the tree's existence? Most writers who have noticed the decay of larch timber are inclined to ascribe it to a specifically unnutritive, that is, an inappropriate soil. Thus, in a letter from Dunkeld, a copy of which has just been handed to me, the writer observes—'I am sorry to inform you, that in many situations the larch is decaying here before it arrives to a large size, and more especially in moist situations. The larch you know to be a thorough Alpine tree, and therefore *dry subsoil* ought to be chosen. Crags and rocks, where there is barely soil sufficient for the nourishment of any other tree, are places suited to the larch, and where it will grow to be a giant forest-tree, and as sound and compact as boxwood.' 'Oak timber,' Mr. Knight says, 'is found to decay most rapidly, generally when it has been grown in soil of small depth; and to some defect of the soil the decay of the *larch* timber must, I conceive, be attributed. A *wet soil*, by destroying all but the superficial roots, may, I think, act like a light or shallow soil. The larch shows no disposition whatever to decay when planted in deep argillaceous loam, and I have not even seen it decay in this country in the manner described by the Duke of Portland.' A *dryness* of soil, then, however writers may differ in

respect to situation and depth, appears to be insisted upon as a *sine qua non* for the healthy progress of the larch; but the Duke of Portland distinctly says that it is in a *dry soil* particularly that he has found the tree to decay at the heart when it had attained the age of thirty or forty years! How are these anomalies to be reconciled? I proposed to His Grace to analyse by chemical tests any small portions of the soil which he would cause to be forwarded to me, hoping that, by a bare possibility, some deleterious matter might be detected in portions of that soil in which the trees were found to decay, which did not exist in those portions of soil which carried sound timber. With that promptitude which characterises this nobleman, His Grace honoured me with an immediate reply. The Noble Duke observed, that he could doubtless procure the specimens I requested, but that the analysis of such small portions could scarcely yield any satisfactory result, as no one could be certain that the parcels selected contained the causes of the decay of the trees. Such had been the extent of the malady upon the property of one gentleman (half his trees having exhibited symptoms of sickness), that he had determined to cut down the whole of his extensive plantations. But as these trees *had flourished* for many years, it is evident that the roots, as long as the trees flourished, had not been attacked with the disease, which in the end proved fatal to them. 'I see,' concludes the Noble Duke, 'larches grow luxuriantly where all the good soil has been taken away; and I

also see that they are very much benefited by the good preparation and improvement of the soil previously to their being planted. I am quite at a loss to reconcile facts apparently so discordant. I should not think that anything but *an examination of the soil on a great scale, and in many places*, can possibly detect the causes of the mischief.'

"Shortly after I received this letter, I met with a passage in the 'Gardener's Magazine' directly applicable to the subject under consideration. It is to be found in vol. vii. p. 374 of that work, and is from the pen of an able correspondent, Mr. Archibald Gorrie, bearing date February 10th, 1831. After stating that the larch has been found to decay, and also to remain unaffected by disease in almost every species of soil and subsoil, Mr. Gorrie observes:

—'This being the case, we are led to suppose that the rot in the larch takes its rise from something accidental, rather than from any natural property in the soil.' The practice of planting larches after Scotch pines has, he considers, led to fatal results. He 'has recently discovered, in numerous instances, that where this has taken place, the *rot uniformly commences in fearfully numerous individual instances*.' The disease takes place in seven or eight years after planting; 'while plantations of the same kind on the same estate, planted at the same period, and in every respect similarly circumstanced as the other, *with the important exception that they did not follow the Scotch pine*, continue entirely free from the rot.'

More to the same effect, and bearing upon the same fact, follows; and so impressed was I by this to me new view of the exciting cause of the malady, that I copied the whole passage, and sent it immediately to the Duke of Portland. Two days afterwards I received an answer from His Grace, wherein he shortly observes: 'I am sorry to say that the decay of the larches in Nottinghamshire *is not to be accounted for* in the manner supposed by Mr. Gorrie; for *there certainly they had not been preceded by the Scotch firs.*'

"Thus then rests the whole case at present. We are baffled in every conjecture."

M. de Candolle of Geneva, having been written to by the editor of the "Quarterly Journal of Agriculture" about 1833, responds as follows, after a few prefatory remarks:—"When I wished to answer you, I felt the necessity of gaining information from some friends who inhabit some of the Alpine cantons, where I can see the greater number of larch trees. I have at last received the greater part of those documents, several of which I owe to M. de Charpentier (the illustrious geologist who has so well described the Pyrenees), and to Emmanuel Thomas. Notwithstanding those communications and my own observations, you will perhaps think that your questions are not *completely* or *satisfactorily* answered, but you will at least perceive, from my anxiety to get information, how much I wished to enter into your views.

"Although I have traversed large forests composed of larches, and in very different situations, yet I have

never observed the two diseases which attack those trees in your country. All my Alpine correspondents agree with me on this point, and have never seen anything of the kind. Moreover, we can even name the larch as the Alpine tree which is less liable to disease than any other. There is a peculiarity which all persons accustomed to observe these trees have been struck with, namely, that the trunks are remarkably healthy. They are, in particular, rarely attacked by the *dermestes*, which are so formidable to firs. Sometimes, but very seldom, we see a small caterpillar devouring the leaves, but no damage results from it. M. de Charpentier has even seen in the Valais, in July 1820, all the trees from the Valley of Conches to the bottom of that of Ferset, bereft of their leaves through the same cause, but none of those trees perished. Sometimes also we see the larches having a wound or resinous cancer, but it does not present the regular symptoms which you describe. On the contrary, it seems to proceed from some accidental cause, such as a blow or knock, which the tree may have received when it *was in full sap*.

"All these observations incline me to think that the cause of the diseases which attack your larches must be sought for in some difference existing in the physical nature, or in the culture of your trees and ours. We do not think that the nature of the soil should have a very marked influence, for the larch is not particular about the soil where it grows, and seems only to fear extremes, which are fortunately rare. Marshy grounds

are the only ones it essentially dreads, and it is never found in that kind of soil. I think there is some exaggeration in saying that it is fond of pebbly ground. It may grow in a soil composed of stones and gravel, but it does not flourish in too strong a soil, and amongst too hard pebbles. Its roots find too little room for expansion in them, and the tree is always stunted. Light and sandy soils do not suit it either in our climate, which is subject to long droughts during the summer; but if the sands are moderately damp, the larch grows well in it. M. de Charpentier mentions on this head, the magnificent plantations of Moritzbourg, near Dresden, which grow in sands almost pure, not marshy, but habitually and moderately moistened by the filtrations from large ponds in the neighbourhood. Thus all extremes in the nature of the soil are hurtful to the larch, but otherwise it thrives in all common soils. If it does not grow well on soils where pines flourish, it is because the latter like hard and dry soils, which the larch does not. I do not know if the juices exhaled from the roots of the pines are hurtful to the larch, but I would be inclined to think so, since those two trees are of the same family, and must throw out resinous matters analogous to each other. Your observation would tend to confirm this result of theory. The elevation above the level of the sea may have more influence on the phenomena than the soil, but only in an indirect manner. Thus we might mention the existence of beautiful plantations of larches at very different heights, provided other circumstances compensate for

those. M. de Charpentier mentions with admiration the larch forests of Moritzbourg and of Tharanz, near Dresden, which are only 238 feet above the level of the sea, and which at forty or fifty years old rival in size the most beautiful forests in the Valais. I myself have seen in the Vosges, and in some valleys of Dauphiny, forests of larches (sown in the Vosges, but spontaneous in Dauphiny), flourishing at very trifling heights; but I am inclined to believe that larches can grow at a lower height in our climate, where the air is pure and the atmosphere less damp than in your country.

“I can satisfy myself with a tolerably good account of the facts known concerning the growth of larches. These trees generally thrive on the declivities of our mountains, seldom on flat places, because on declivities there is always a little dampness on the earth coming from the summit, and at the same time the trees, on account of the inequality of their bases, have more space at their tops, and are better exposed to the light; whereas flat places are often too dry, and the trees being all of the same height, overshadow each other. Amongst declivities, those which are connected with summits covered with perpetual snow are those where larches grow best; because there they grow slightly, and continually watered, and at the same time their top well exposed to the sun. Declivities, and, in general, elevated countries, suit larches best, because the action of the light is more intense than in low countries. Yet the larch succeeds well enough

in countries only a little elevated above the level of the sea, provided the atmosphere be not obscured by fogs and constant cloudiness.

“The constant dryness of the air of the Alps is one of the causes which makes it prosper there. The dampness of the air tends to diminish the evaporation of the leaves, so necessary to that tree. You have observed, and I had remarked it, that the larch does not grow well near the sea. That proves what I have just advanced. The sea produces an increase of dampness in the air on two accounts: 1st, like the surface of fresh water, it exhales much water into the atmosphere; 2d, the little watery particles which are thrown out by the waves are carried here and there, and deposited on all solid bodies; they leave on them a certain quality of salts, more or less deliquescent (muriates of lime and soda), and these deposits constantly attract dampness on those surfaces; whence it is that sea-dampness produces rust more actively than any other dampness.

“The want of a sufficiently intense light, owing to the obliquity of the solar rays, and to the opacity of the atmosphere, and the overdamp state of the latter, all appear to me permanent causes which, in your climate, must predispose the larches to a state of watery plethora, which is probably the cause of the destruction remarked in the heart of the wood. This cause has little or no effect during the *youth* of the tree, because then its vegetation is vigorous; but it goes on increasing until the tree arrives at the age when, in

all trees, vegetation begins to be feebler. I cannot so well perceive the connection of these general facts with the ulceration of the bark.

“ If, after these observations, I dare to hazard some advice concerning a country I do not know, this is what I would say: First, I have no doubt that the elevated parts of your country are more suitable than the lower, provided the ground be neither too dry nor too hard, I need not add nor too marshy, for that is a fact well known. Second, I think that your declivities would do better than summits, and particularly, if you have tops of mountains covered with turf and marshes (as in some parts of Belgium); the declivities below which will be the best. In our country, we observe that the larch grows better in those parts exposed to the north than to the south. The difference is sometimes so striking that, in the valleys parallel to the equator, it is not rare to see all the side to the north covered with larches, and none at all to the south. I am inclined to believe that this arises from the irregularity of our spring, which causes the buds of the larches to be too precocious in the southern declivities, and, consequently, they are frequently frozen. This happens to our walnut trees, which, although they are affected by the frost, grow better on the northern declivities than on the southern, where their buds, being too forward, are frozen. In your latitude, where the spring is more regular, I think this cause will not operate; and I would say that, if the southern declivities be not too dry, the larches will succeed

better than here. But what I attach more importance to is, that I think your plantations of larches are too close. You seem to plant them generally at the distance of 3 or 4 feet from each other. It is much closer than with us, and I think you would do well, at least, to double, or even to triple, that distance. Air and light would penetrate better into the forests, and would correct the defects which I attribute to the want of evaporation and the decomposition of the carbonic acid. You should not certainly place the young and yet small larches at the distance of 10 feet, but you should follow the method employed in the forests of pitch pines, to keep them close in their youth, then to thin them gradually, so as to bring them to the distance of 10 feet when twenty years old. One might easily make a trial of this method on the young forests which have not yet reached the age when the disease of the heart of the tree begins to show itself. This thinning of the trees appears to me the most important point I dare recommend to you. Considering your atmospherical circumstances, your trees should be at greater distance than ours, and they are at considerably less. Try this on a small space, and experience will show if the theory be just or no. I give it with the greater confidence, as it is supported by the judgment of the most expert and most judicious observers, namely, M. de Charpentier and Emmanuel Thomas. They even propose the distance of 15 feet, considering what takes place in the Alps, where the larches generally make forests very far from close. As to the

choice of seeds, I am not one of those who attach great importance to it; but it cannot be denied that trees growing from seeds taken from diseased trees must be more liable to these same diseases: therefore, you would do well to get your seeds from the Alps. In choosing these seeds, care should be taken to ascertain how they have been gathered. They assure me that in the Tyrol they place the cones near the fire to make them open; consequently they are too much dried, which alters their quality. Those gathered in the Valais are generally opened by the heat of the sun or over a slow fire, and are considered better. Emmanuel Thomas, who trades in them at Berg, in the Canton de Vaud, sells them at 2 francs 50 centimes the half kilogramme (about 2s. for $3\frac{1}{2}$ pounds, English money and weight), and all our agriculturists praise their quality. If experience has proved to you the superiority of foreign seeds, could you not obtain the importation of them, free of duty, as an article which may be considered of first importance; or at least might not your Agricultural Societies for some time reimburse the duty (6d. per lb.) to those who should sow the imported seed?

“I have forgotten to say that, as a practical advice of M. Thomas, he recommends that the transplantation of larch plants should take place in autumn and not in spring. I do not know what your custom is in this respect, therefore I do not know how far this observation may be useful to you.

“I think I have answered all your questions, and I

should be happy could I think that your country will derive some benefit from these reflections. I give them the best chance of success in addressing them to a person accustomed to join theory to practice, and who will know how to modify them according to circumstances. I cannot conclude this letter without returning my thanks for the obliging manner in which you have given an account of my theory on the rotation of crops, and upon which I receive every day some strong confirmation. Your Journal appears to me to be a model for Journals of that kind, and I have read a great number of its articles with a lively interest."

CHAPTER XXIV.

GAME AND OTHER ANIMALS INJURIOUS TO LARCH.

LARCH is tender, delicate, and sensitive to a high degree, and intolerant of any interference in any part, and in nothing more so than its bark. If the bark is either bruised or eaten in any way, or any of the branches or spray roughly rustled with the horns of animals, or crushed by ruthlessly pushing them aside in going amongst them, in any such case, consequences to the extent of seriously interfering with the growth, or entirely destroying the tree, are the inevitable results.

Larch should, therefore, more than any forest tree I am acquainted with, be kept perfectly free of any interference. Neither cattle, horses, sheep, hares, nor rabbits should on any account be allowed amongst them till the bark is well hardened and furrowed, the side branches decayed to a height above their reach, and the stems left clean and clear to a height of 6 or 8 feet, after which light cattle, or old cows, or sheep, may be grazed in larch plantations without inflicting any injury upon them, but even conferring a positive good. Hares and rabbits should not be allowed access

to the trees till they are considerably advanced—that is to say, till all live branches are out of their reach/ and the bark of the tree well corticated—and even then they often bark the exposed parts of the roots, where the bark is thin and tender. Rabbits are at all times very destructive to young larch plantations, and therefore should either be extirpated, or kept from them by means of wire netting, stone dykes, or other means. It is not only the top leading shoot that is to be protected and kept from harm, but the side branches as well; and the very lowest tier has equally as much need of being preserved entire as any branch on the whole tree, for it is from the lower branches that the roots are nourished; and this circumstance cannot be too strongly impressed upon every forester, that the roots are supplied with cambium principally from the lower branches. If any one wishes to test the truth of this, he has only to prune a few trees, and observe the difference between *their* growth and those not pruned, and he will find the growth of the tree supremely favoured by having all its branches on.

Single trees are best protected by ample cages where the branches come low down, but where the stem is clear at least three or four feet up, some less expensive means of protection may be employed, such as the bark of oak or larch bound round loosely, a faggot of quick-thorn or strong heather, or R. Davidson's composition may be used, if only to prevent hares or rabbits injuring them for a season, or during an occasional snow-storm. The size of plantation, situation, age, extent,

exposure to animals, &c., all contribute in determining the kind and mode of protection to be adopted. Of all trees in the forest, deer in rutting time inflict most injury upon the larch by rubbing and barking it with their horns. Perhaps the light airiness of the branches, which are easily agitated by the least touch or breath of wind, provokes and arouses the combative propensities of the animal, and thus incites attacks which a more rigid tree does not.

After thirty or forty years old, larch plantations, where the soil is dry, may be depastured with sheep during summer; and even in winter they do no damage, except that in severe storms they bark the exposed roots, and hence must be excluded when the latter circumstance is likely to occur.

CHAPTER XXV.

NURSERYMEN'S OPINIONS OF SEEDS AND SEEDLINGS.

WITH a view to establish and confirm one or other of the various theories and opinions entertained respecting the comparative merits of home and foreign seed and seedling plants, I have from time to time corresponded with some of the leading men in the trade, whose experience and position entitle them to speak upon the subject, and have much pleasure in announcing their views in the annexed answers to questions put to them.

The answers, in some cases, are conflicting, and somewhat different from what might have been expected; but it is just possible that the point of the questions may, in some cases, have been obscure, and thus led to answers somewhat different being given.

1. Whether is home or foreign (Tyrolese) seed most productive; that is to say, from a given quantity (1 lb.) of seed? Which produces the greatest number of plants?

If both are of good quality, there is no difference in producing power. (John Methven, Edinburgh.)

Say 5000 foreign ; home, 2500. (William Christie, Fochabers.)

Home, about 1500 ; foreign, 3000. (B. Reid & Co., Aberdeen.)

Foreign produces about double the quantity of home. The reason being, foreign seed is taken out by sun heat, and home seed by artificial heat ; the former being perfectly clean, and the latter mixed with the husks. (Cardno & Darling, Aberdeen.)

More plants can be produced from Tyrolese larch seed than home grown, granting that both are equally cleaned. (Stuart, Mein, & Allan, Kelso.)

Foreign most productive. (Howden & Company, Inverness.)

If you can get home larch seed as well cleaned as foreign there should not be much difference ; but it seldom or never is so well cleaned, and chaff is often paid for in home seed. (Little & Ballantine, Carlisle.)

Tyrolese most productive. (William Fell & Co., Hexham.)

Foreign generally produces double the number of plants. (Thomas Imrie & Sons, Ayr.)

We always count on a much better crop from Tyrolese than from home seed. This season we sowed the latter five times thicker than the former, and the crop of each is about equal. (Dicksons & Co., Edinburgh.)

Foreign. One lb. would produce four times the number of seedlings you would get from 1 lb. of seed of home saving. (Thomas Kennedy & Co., Dumfries.)

2. Whether does home or foreign seed produce the best marketable plants, or such as command the highest price in the market?

Both equally good. (John Methven, Edinburgh.)

Equal. (William Christie, Fochabers.)

Home. (B. Reid & Co., Aberdeen.)

Home. (Cardno & Darling, Aberdeen.)

Foreign seed will produce the best market plants, and that in the shortest time. (Stuart, Mein, & Allan, Kelso.)

Home. (Howden & Company, Inverness.)

Home. (Little & Ballantine, Carlisle.)

Home. (Richard Smith, Worcester.)

Home. (William Fell & Co., Hexham.)

Home. (Thomas Imrie & Sons, Ayr.)

Home. (William Sim, Forres.)

Home. (Dicksons & Co., Edinburgh.)

Home. (Thomas Kennedy & Co., Dumfries.)

3. Whether are the seedlings and young plants, so long as in the nursery, up to three or four years old, most liable to injury from spring frosts?

From their tendency to make an early growth, foreign seedlings are more liable than home. (John Methven, Edinburgh.)

Foreign, but not much difference. (William Christie, Fochabers.)

Foreign. (B. Reid & Co., Aberdeen.)

Foreign. (Cardno & Darling, Aberdeen.)

Foreign suffers most from spring frosts in low districts, but there is not very much difference between them in this respect. (Stuart, Mein, & Allan, Kelso.)

Foreign. (Howden & Company, Inverness.)

The Tyrolese is most liable to be frosted. (Little & Ballantine, Carlisle.)

Foreign. (Richard Smith, Worcester.)

Foreign. (William Fell & Co., Hexham.)

Foreign. (Thomas Imrie & Sons, Ayr.)

Foreign. (William Sim, Forres.)

Tyrolese. (Dicksons & Co., Edinburgh.)

Foreign. (Thomas Kennedy & Co., Dumfries.)

4. Whether do the plants of home or foreign produce ripen their wood earliest and best in autumn?

Home. (John Methven, Edinburgh.)

Home. (William Christie, Fochabers.)

Home. (B. Reid & Co., Aberdeen) .

After the plants are two or three years old we know little or no difference in the time of ripening. (Cardno & Darling, Aberdeen.)

Home plants make shortest growth and ripen wood soonest in the season. (Stuart, Mein, & Allan, Kelso)

Home. (Howden & Company, Inverness.)

Home. (Little & Ballantine, Carlisle.)

Home. (Richard Smith, Worcester.)

Foreign. (William Fell & Co., Hexham.)

Home. (Thomas Imrie & Sons, Ayr.)

Home. (William Sim, Forres.)

Although the Tyrolese seem to ripen and lose their

foliage sooner than the native in autumn, we have never observed either of them suffer from autumn frosts. (Dicksons & Co., Edinburgh.)

Home. (Thomas Kennedy & Co., Dumfries.)

5. Whether are the plants of home or foreign produce most disposed to produce lateral or side shoots on the young wood ?

Foreign. As a consequence of having the top bud frosted. (John Methven, Edinburgh.)

Don't know any difference. (William Christie, Fochabers.)

Foreign. (B. Reid & Co., Aberdeen.)

Our opinion is, that little side shoots on the young wood are produced by extra-vigorous growth in both foreign and home saved seed. (Cardno & Darling, Aberdeen.)

Home plants are most disposed to put forth little side shoots. (Stuart, Mein, & Allan, Kelso.)

Home. (Howden & Company, Inverness.)

Foreign. As the leaders being nipped in spring by frost tend to make them do this. (William Fell & Co., Hexham.)

Foreign, to our experience; but in the south we find little difference. (Thomas Imrie & Sons, Ayr.)

Home. (William Sim, Forres.)

With us the native in its young state seems to be more luxuriant and more disposed to put out little side shoots. (Dicksons & Co., Edinburgh.)

We have noticed no difference between home and

foreign as regards their tendency to produce side shoots.
(Thomas Kennedy & Co., Dumfries.)

6. What is the usual difference of price between home and foreign seed ?

Usually about the same. (John Methven, Edinburgh.)

Foreign usually cheaper than native, but this spring it was higher. (B. Reid & Co., Aberdeen.)

The price depends entirely on the crop at home, and is very variable. (Cardno & Darling, Aberdeen.)

The difference in price is usually 1s. to 2s. per cwt., but varies very much. (Stuart, Mein, & Allan, Kelso.)

Home seed generally dearer; depends on crop. (Howden & Company, Inverness.)

The price depends upon the supply and the demand. Some years the home seed is a good deal cheaper, other years nearly double the price that Tyrolese is. (Little & Ballantyne, Carlisle.)

Home seed is dearest, being about fifty per cent. dearer than foreign. (William Fell & Co., Hexham.)

Home or native larch is worth more than foreign. (Thomas Imrie & Sons, Ayr.)

Home should be worth at least 30s. to 40s. per 100,000 (one-year seedlings) more than foreign. (William Sim, Forres.)

With a good crop both at home and on the Continent there would probably not be much difference in the price per cwt., but last spring the Continental seed was nearly double the price of home seed, although in

reality as regards the yield it was the cheaper of the two. (Dicksons & Co., Edinburgh.)

Foreign seed from three collectors in 1879 and 1880 cost 110s., 175s., and 198s. per cwt., all clean seed. Home seed from five collectors, in same season cost 110s., 120s., 130s., 130s., 140s. per cwt., and, as usual with home seed, it was very dirty. Of the five named above, that at 120s. produced us double the seedlings per pound of any other. (Thomas Kennedy & Co., Dumfries.)

· 7. Give any other distinguishing features observable in the two, and anything more or less favourable in the one than in the other.

From the foregoing it will be seen that the foreign seedling is much more tender than the home, but if in favourable seasons it escapes injury from frost for two seasons and is then transplanted, it appears in all respects to be as hardy as the home, and there appears to be no appreciable difference in the plants. In a severe frost as large a proportion as nine in ten of the foreign seedlings are rendered useless, while seldom over one in ten of the home suffers. (John Methven, Edinburgh.)

We believe plants from native seed are the best for nurserymen, being much hardier, and seldom damaged by frosts in the seed-bed or nursery lines; *foreign larch*, however, after six years old, gets acclimatised and hardier, and with difficulty can be distinguished from home. (B. Reid & Co., Aberdeen.)

Plants from home-saved seed are always more vigorous than those from foreign seed. We always prefer home seed when it can be got; but the great defect in it is the difficulty in cleaning, which makes it far more costly than foreign. (Cardno & Darling, Aberdeen.)

We think that taking into consideration the fact of the more sturdy slow growth of home plants, they are less liable to the attack of disease and insects. (Stuart, Mein, & Allan, Kelso.)

Home better in every way. (Howden & Company, Inverness.)

We think the home makes the best tree to plant; foreign is liable to get browned in appearance after awhile, while home maintains a more healthy look, and, generally speaking, seems to do better and thrive more than the foreign does in this climate. (William Fell & Co., Hexham.)

We find that the foliage of the foreign is considerably lighter in colour and longer in the needles than the home. In all, we consider that the *true native larch* cannot be surpassed for any exposure, and it is our opinion that Tyrolese or foreign ought to be avoided in Scotland, as we have of late years observed in many plantations around here that the tops of the foreign larch suffer more or less when they reach the height of six or eight feet, while the home push steadily along, making short growths compared with foreign, but in most cases well ripened in early autumn. (Thomas Imrie & Sons, Ayr.)

We consider that, except where foresters plant one year's seedlings, this is almost exclusively a nurseryman's question, for being transplanted for two years, we never have any loss from frost in the case of either, and we could not after that detect any difference between the two. It is possible that the Tyrolese seedlings after two years' acclimatisation lose the habit of starting into growth quite so early in spring. (Dicksons & Co., Edinburgh.)

The only difference between home and foreign plants with us is the liability of the latter to be cut down by early frosts. (Thomas Kennedy & Co., Dumfries.)

CHAPTER XXVI.

CONCLUSION.

It would scarcely be a fitting conclusion of my subject, considering the varied and conflicting views and opinions of others that are here and there interspersed, did I not somewhat more definitely state what are and what are not mine as distinguished from theirs ; and in order to do this, it is necessary to make a brief but general summary of at least the primary and leading subjects treated of, and elucidate more clearly some points of obscurity.

First. The subject of diseased seed, as being the producing cause of diseased trees, young or old, should have little or no importance attached to it ; for in the nature of things, although the quality of the seed in a very important degree determines the condition of the succeeding crop so far as respects grain, annuals of all sorts, and perhaps also biennials, yet its influence upon forest trees does not at all appear to extend beyond the seed-bed, or nursery line at farthest. If the seed is plump, sound, and good, the seedlings will correspondingly benefit by their being strong and healthy ; and this advantage as a start in the race of

growth extends a farther or shorter way according to the favourable or unfavourable influences met with ; and on the other hand, if the seed is diseased, weak, and feeble, the plants produced therefrom will likewise partake of these unfavourable conditions, and either soon languish and die, or recover and attain a perfectly healthy state, and remain so. All plants grown from imperfectly ripened or diseased seed are more liable to attacks of insects, blight, &c., than those grown from seed sound and good : for example, plants grown from seed-corn imperfectly filled and ripened are much more liable to be attacked by grub-worm than those from seed plump and sound ; and it may safely be inferred that corresponding results take place with diseased tree-seed, to which larch forms no exception ; and any forester who knows his profession is at no loss, in selecting his plants, in determining what has been their antecedents in respect of seed, and consequently what their future prospects. While the nurseryman may with perfect safety be left to select the seed and grow the seedlings, it becomes the duty of every forester to exercise great circumspection in choosing and selecting the plants, by seeing that they are strong, perfectly healthy, have not been grown in an overcrowded state, that they are well rooted, that the wood is properly ripened, especially the top shoots and buds, and that they are of the proper age and size to suit the herbage, soil, and situation where they are destined permanently to grow.

Second. No possible, or rather practicable, amount

of labour should be withheld from the ground preparatory to planting. If wet, it should be thoroughly drained, so that no water stand on the surface in any part, not even the smallest spot; and where the surface of the ground is broken and uneven, it is often difficult to attain this without putting the drains very close together; but as they do not require to be deep (20 inches or thereby), the expense is well bestowed and should not be withheld. If the soil is stiff and close, which is often the case, it should invariably be well loosened and broken, either by digging, ploughing, trenching, or foot-picking, that the roots may freely enter, and ramify without interruption.

Third. For several years after planting into the forest ground the trees require the greatest possible care and protection. The care and attention first required by the tree should begin with its growth, and end only when it is cut down. It must at all times be seen to that the roots are safe, that no herbage of any kind interferes with the growth and development of the side branches, and that the top likewise has perfect freedom. Animals of all kinds must be kept entirely from them, so that neither root, stem, branch, twig, bark, bud, nor leaf is in any way injured by them; for the slightest bruise of the bark, even by rustling or rubbing against it, causes very serious damage, which often results in the death of the tree. Insects as well as animals often inflict much damage, chiefly by poisoning or devouring the foliage; but from these the tree usually soon recovers, sustaining thereby only

a temporary check of growth, which it generally regains next season. When, however, the tree becomes vitally diseased, insects attack not only the foliage, but also the bark, and then the wood, and ultimately terminate its existence, not by killing it, but rather performing the functions of burial according to nature's unerring laws.

Fourth. The hazard of laying down one fixed unbending rule for thinning is almost as great as that of recommending no thinning at all. There are, however, some general rules which may be laid down with much certainty, definite objects being thereby sought to be attained, such as,—

A certain amount of *air* for the proper growth and development of the tree; therefore, thin to afford the requisite amount. *Light* is also necessary, and therefore the rays of the sun must fall upon the foliage of every branch, that it may be kept in perfect health and vigour. The roots of the tree, as well as the branches, must have room to spread—the former under ground, the latter above it—so that food may be taken up for nourishment, anchorage given to the stem, and proper balance maintained amongst all its members. Trees require different and often opposite kinds of treatment at different stages of growth; thus while young ones require much light and a free circulation of air, middle-aged and old ones require considerable shade and moisture. Young trees, again, enjoy thinning, while older ones dislike any disturbance or interference of the kind. The roots of young trees are soft, spongy,

and elastic, and readily accommodate themselves to new circumstances and conditions of life, while old ones are hard, full of resin, and on the least fracture or injury their juices crystallise and stop the flowing sap.

Little or no thinning should be done after the trees are about thirty years old—unless, indeed, under very exceptional circumstances, when the thinning had been neglected, and the soil and situation are more than usually favourable. During the growth of the tree the zones or layers should be about $\frac{1}{8}$ th of an inch till forty years, $\frac{1}{6}$ th till fifty, $\frac{1}{4}$ th till sixty; and on to maturity at about eighty years or thereby. The form of the tree, both stem and general outline, should, when young, be conical, and its girth in inches above the swell of the roots corresponding with its feet in height; at sixty years old its girth at ten feet from the ground should be equal to its feet in height, and so on in proportion throughout its growth.

Fifth. Every plantation requires constant attention at every stage of growth, and at none more so than when nearly approaching maturity, so that not a single tree be cut too soon, nor one allowed to stand after it is ripe for cutting; and this, it is needless to say, involves more than one difficulty. From the very great and distinct varieties of trees of the same species, and in none more so than the larch, it is easily understood how some trees attain maturity so much sooner than others,—some growing larger than

others, under the same outward conditions ; the wood of some varieties harder than that of others, more durable, &c. The difference of variety, too, has contributed in no small degree to perplex the student in his researches to ascertain the causes of disease and various other phenomena daily presenting themselves.

While, on the one hand, the very distinct variety of plants produced from the same seed-bed has had by far too little attention paid to it, on the other hand, much of what has been said about the *two* varieties, the red and white flowering, has to a great extent been misleading. There are not only the red and white flowering varieties, but there are at least four or five others whose colour of flowers greatly differ, and the cones still more so. It is very interesting to notice how the colour of the flower is perpetuated in the cone. The red flower produces a red cone, the white flower a light green cone, and so on with all the other shades and varieties. If the theory that the colour of the flower indicates the colour of the wood be a true and reliable one, it would be exceedingly useful, as thereby, in selecting a tree for any special purpose of commerce or industry, it could be known to a certainty by the cone what the colour and consequently the quality of the wood is, before the tree is cut down. As a matter of fact, however, the theory fails in this respect, and is therefore of no practical utility, however interesting and instructive it is in other ways. I have cut many trees of the

white-flowering variety, and found the heart-wood as red and hard almost as mahogany, and also trees of the red-flowering variety with the duramen very white and soft. The four notable larches at Menzie Castle are all of different varieties. The largest is of the red, while the smaller ones are of the purple flowering varieties, and of different shades of colour.

Sixth. The opinions held respecting plants grown from home and foreign seed are so conflicting, that the subject requires more than a passing glance.

If the old, magnificent trees first planted in this country, already historical, are the direct products of foreign seed, then we have positive proof of their super-excellence, and what more do we require or wish for? But if asked how it is known the old trees are the direct product of foreign seed, I answer, Because the proof is all in their favour that they are so, and nothing worthy of proof is advanced against them. Some who favour the opinion that home-grown plants are superior to foreign ones affirm that the red-flowering and red-wooded varieties are all of home growth, while the white, soft, and less valuable are from foreign seed. Such theories are, however, untenable, and do not stand the test of actual investigation; for in a bed of home-grown plants there are many distinct varieties, and in a bed of foreign there is also the same difference. There is generally a very marked distinction between the seedlings of home and foreign produce while in the seed-bed, and sometimes even in the nursery line; but every year the distinc-

tion grows more and more faint, till it entirely disappears; and no one, not even the most acute observer, can tell which are from home and which from foreign seed.

In the seedling beds the difference between home and foreign produce is sometimes very distinct, and at other times scarcely visible—the reason being, that the foreign and home seed is at times (owing to the seasons) of nearly the same quality. If in Britain the seed has matured well, and in the Continent it has ripened badly, the plants produced therefrom will be nearer equal than when grown from seed produced under the opposite conditions. Plants from foreign seed, however, have the disadvantage of being more liable to be frost-bitten both in spring and autumn than those of home growth, and that is the only material difference and disadvantage they possess. This liability to frost, however, soon passes away, and then there is no difference—at least none visible or of any practical importance.

Seventh. The bark disease or blister has ever been to foresters a source of great alarm and anxiety, and yet nothing like a general satisfactory conclusion has been arrived at. It is my unqualified opinion that the primary cause of blister is owing to the bark becoming injured by cold and wet in spring and summer. In low, damp situations it is always worse than on elevated ground with a dry soil. I find, too, that while the bark is injured above the rough surface, it is generally quite safe close to the ground; and young

trees that were killed down to near the ground in 1879 are now producing young shoots, and promise fair to again become trees. The bark is very tender, and all the more so if the texture is poor and dry, and is more liable to disease between the period when it sheds the outer thin, transparent, straw-coloured bark, and that of assuming the corky form, than at any other stage of growth. Abundance of air, room for branches, dry porous soil, and free open exposure, are the conditions under which it thrives best, and the opposite those where it thrives worst. In confirmation of this opinion, it is to be observed that all dry hilly districts are better adapted for larch than damp flat ones. The Highlands are better than the Lowlands, Wales in general better than England, and some districts in Ireland as good, if not better than either.

Eighth. The larch is by no means a good margin tree when near the sea, as its foliage is easily injured by the salt spray several miles distant when severely exposed, but is as good as any if sufficiently inland and sheltered from the north and east.

Ninth. The larch bears a stronger analogy to hardwood trees than any other coniferæ. It stands thinning well, bears pruning, of which it often stands in need, being liable to double leaders, and if cut over near the ground when young, produces shoots which in due time form excellent trees. From this reproductive peculiarity of the tree it is often found that where ground game abounds, and the young plants are de-

stroyed, and the ground repeatedly planted, ultimately, after a lapse of years, they spring up as if by magic, and produce quite a thicket, from which the ground as much longs to be clear as before it did for plants to cover it.

Tenth. Most trees show their state of maturity and ripeness by the appearance of the outer bark, but it is not so with the larch. The bark of some trees would lead to the conclusion that they are young and of rapid growth, while the rings or zones are so small as scarcely to be counted. Others, again, appear as if the growth was nearly over, and the tree decaying of old age, while the growth and formation of wood are going on more rapidly than at any other period of its life. The growth and health of the tree are at all times best determined by the appearance of the spray and branches and the fruit or cones. By a wise Providence, when a tree begins to decay it makes an undue effort to perpetuate its kind by leaving a succeeding progeny behind it when gone. Trees thus unduly laden with cones are always diseased, although such disease does not always terminate fatally. They may, however, be safely regarded as an indication of an abnormal condition of health.

Eleventh. After about thirty or forty years old, when the ground is dry, the plantation may with advantage be depastured with sheep during summer, and also in winter except in severe weather, when they bark the exposed roots, which should in every case be strictly guarded against.

Twelfth. The crop upon the ground, after the first thinning is done, should never exceed 800 trees per acre; if to cut down as a crop at fifty years, about 300 trees per acre should constitute the crop; and if to stand till eighty years, 200 trees should be upon the ground, as the most economical and useful crop; and it is doubtful if any larch plantation (as a crop grown for profit) should ever contain fewer than 200 trees per acre, or more at any stage of growth after being regulated or thinned the first time than 800 trees per acre upon very dry and airy districts, or 500 when sheltered and the ground disposed to dampness.

Thirteenth. To grow ornamental, fancy, or specimen trees for other than profitable purposes, they require to stand single, and at wide distances apart, from their earliest planting; and their side branches should not at any period be interrupted or impeded in their growth.

This is neither the time nor the place to discuss or determine what the points of commendation in an ornamental tree, as distinguished from a profitable one, are or ought to be; otherwise it might possibly have been shown that there is equal beauty in a clean, grand, and noble bole, as in the greatest and most graceful display of branch, spray, and foliage that can adorn the most gigantic but ungainly trunk. In order, however, that the tree be induced to live to a great age and size, it is quite evident it must be placed under circumstances conducive to that end; but the conditions that promote expansive growth with

profusion of branches, limbs, and spray, in effect destroy the qualities of good and valuable timber trees as industrial or commercial subjects.

Fourteenth. It is maintained by most who have paid attention to the cultivation of the larch, that it grows upon almost any quality and description of soil. This is true beyond what even its strongest supporters are probably aware of; for, as a matter of fact, no forest tree with which the writer is acquainted has roots so full of vitality and so tenacious of life as the larch. It will keep vital under conditions the most adverse, and not only continue in life for more than half a century, but will, after lingering that time between life and death, spring into vigorous growth as if by magic, and commence a growth equal to what is experienced in a young and newly planted tree.

Fifteenth. The effects of draining plantation ground are often marvellous, and the growth so greatly promoted as to create astonishment. This is most clearly seen in plantations that have been planted on ground somewhat unsuitable on account of wetness, hardness, or strong surface herbage. Advantages are gained to the plants or advanced trees by drainage much beyond what simply drawing off the water could effect; and the explanation of the whole matter is, that the excavations of the drains yield food and nourishment to the roots of the trees, which they very readily find and appropriate. It is quite surprising how much plant food is afforded by spreading even half an inch of soil over the surface. How the growth

is really produced is not well known, but that there is a superiority of growth promoted by draining and spreading the excavations on the surface beyond what would be expected from such apparently unimportant operations, cannot be gainsaid. The surface-feeding of tree roots has, however, so much engrossed the writer's attention of late years, ~~that~~ that he regards it as a branch of forestry requiring infinitely more attention than it has hitherto received.

Sixteenth. Ridge or mound planting is a system attended with such favourable results as highly to commend itself, and is certain to increase in favour. It consists simply in laying up the ground in mounds or ridges, varying in breadth from 6 to 20 or 30 feet, according to the wetness and fall of the ground. Much ground too wet for the growth of larch, or indeed trees of any kind, is thereby rendered capable of growing excellent wood. The advantages of the practice are, that on level ground, with little fall for drainage, the roots of the trees are raised above the level of the water, and the soil having been necessarily broken in the operation of laying up the ridges, renders it suitable for the plants. The ridges, too, if high, impart to the ground a kind of hill and vale character, which all trees prefer, and grow better in than in soil of equal quality in a flat and level form.

Seventeenth. The uprooting or blowing down of trees, especially young and healthy ones, is always a matter of deep regret and much solicitude; and as no one

can foresee what is to happen, so none can entirely prevent it; but, as already fully explained, drying the ground and rendering it fit for the roots spreading and maintaining their vitality, are helpful means of preventing the uprooting or blowing down of trees. When it is foreseen by the upheaving of the roots that a tree is in imminent danger of being blown down, a few large stones should be laid over the upheaving mass, and when this is properly done, it is wonderful how it protects the tree. The same means employed to prevent trees from being blown down are equally efficient in sustaining uprooted ones after having been set up again. By the heaving of the ground the stones gradually sink into it, and so embed themselves as greatly to secure the stability of the trees; and if the stones are only heavy enough, success is certain.

Eighteenth. Reference has frequently been made to the tenacity of life of the roots, and to the circumstance that no tree will come so near the point of death and perfectly recover itself as that of the larch. Trees and also plantations have from time to time been left as dying testimonials, and yet have greatly surprised many by their complete recovery. I saw a tree lately which at fifteen years' growth had been so covered with blister as all but to extinguish its vitality, and it is now (fifty years old) growing fast, and in every way quite healthy; and this circumstance so far qualifies the saying that it is much more common to see a dying than a dead larch. On some soils the trees are seriously affected with trunk-rot—

sometimes termed dry-rot, pumping, &c., from the resemblance the tree so affected bears to a wooden pump. This disease is doubtless entirely due to the condition of the soil, and it is found most inveterate where the active soil is good—that is to say, such as promotes early, rapid growth—and the subsoil poor, cold, and wet, or the other extreme—poor sand or gravel. Soils of these descriptions can be rendered comparatively safe for planting larch by adopting the ridge or mound practice referred to in paragraph sixteenth, or a modification of it, by throwing two furrows together with the plough, clearing out and deepening the space between with the spade, and planting small plants in rows along the top of the ridge. Thorough draining, removal of the surface turf, abundance of room, and free circulation of air, are all beneficial and preventive means.

Nineteenth. The surface-feeding of trees is of no small importance, for it often happens that some bare, worthless spot is desired to be covered with trees, and they absolutely refuse to grow for want of nourishment. A few turfy excavations of drains chopped small—or indeed any earth, even the poorest, spread over the surface to the depth of an inch or so—will produce a wonderful growth in larch, and secure the object of planting some arid, hard, poor, worthless hillock, where trees would not succeed without either it or some other, and perhaps more expensive, means being employed.

Twentieth. As already said, and not too often repeated,

the larch is both a very tender and delicate tree, and yet remarkably hardy, strong, and tenacious of life. Its foliage, more especially when newly expanded, is very easily injured by cold winds or frost; and its bark when young, and up to the period of becoming hard, scaly, and corky, is equally as tender as the leaves are, and suffers much in the form of blister from cold winds, wet soil, damp atmosphere, frost, and even dull, sunless weather (as in 1879) during spring and summer, to a serious and alarming extent. On the other hand, its young and new wood in winter endures the most intense frost; and the bark, when once it has assumed the corky condition, is proof against all inclemencies of weather. Its roots, and especially its fibres (except, perhaps, in damp rich loam or cold clay), will continue sound and healthy while the tree to which they are attached is lingering for want of air, light, and sunshine, for a period far beyond which any other tree will endure, and ultimately revive and nourish the tree to a great size and age.

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